International Journal of Innovation Engineering and Science Research

Editorial Board

International Journal of Innovation Engineering and Science Research

Volume 5 ISSUE 5 November-December 2021

International Journal of Innovation Engineering and Science Research
(ISSN: 2581-4591)
www.ijiesr.com

Effect of lactic acid fermentation by *Lactobacillus delbrueckii subsp. bulgaricus* on the chromacity of *Moringaoleifera* leaves

HARIMALALA ANDRIAMBELO N.[1], TSIRINIRINDRAVO H.L.[2,3], RAZANAMPARANY J.L[1].

[1] *Laboratory of Biochemistry Applied to Food Sciences and Nutrition. Faculty of Sciences, University of Antananarivo*
[2] *Laboratory of Biotechnology. Faculty of Sciences, University of Antananarivo*
[3] *Indian Ocean Islands University, Madagascar, Mauritius*

ABSTRACT

The nutritional situation in Madagascar is very precarious and structurally fragile. As an indication, 53% of children under 5 are stunted, 42% of children are underweight, 13% suffer from acute malnutrition, 50% suffer from anemia.

To help fight malnutrition in Madagascar, there is the fortification or fortification of staple foods. The fortifying food highlighted in this study is the leaves of *Moringaoleifera* which showed the strong nutritional potential, including a large amount of proteins (> 18%), the quality of amino acids, as well as a large amount of elements. minerals.

However, its use is blocked by its color. Thus, a study of the impact of fermentation, using *Lactobacillus delbrueckii subsp. bulgaricus*, on the color of dried leaves of *Moringaoleifera* was carried out.

Biomasshave grown in the medim.. The OD varied from 0.08 to 0.17. A decrease in the chromacity of the reaction medium was noted. To check whether the fermentation does not negatively affect the fermentation, the total protein and polyphenol content was determined before and after fermentation. The total protein content increased from 3,240 to 4,980 while that of polyphenols decreased from 21,359 to 8,342.

Keywords:*Moringaoleifera, Lactobacillus delbrueckii subsp. Bulgaricus,* Madagascar, malnutrition, fermentation.

I. INTRODUCTION

In Madagascar, malnutrition is both a public health and socio-economic problem that affects a large part of the population, particularly young children, pregnant and breastfeeding women (Pnan III). There are two forms of malnutrition, acute malnutrition and chronic malnutrition, which respectively affect 9% and 47% of children under 5 (Unicef, 2017). Chronic malnutrition affects approximately 2 million Malagasy children, it is the most serious form of malnutrition; it is more often the consequence

of a lack of quality of food than of a lack of quantity. Thus, 60% of children in the highlands are affected by stunting (World Bank, 2018) which has impacts on the physical growth, cognitive development of the child and it is not without future consequences on development country's economy (Unicef, 2017). One of the causes of chronic malnutrition is "hidden hunger" fostered by food insecurity (Agsanv, 2014).

Thus, strategies are implemented to fight against malnutrition, including fortification or enrichment of staple foods (PNANIII). The fortifying food highlighted in this study is *Moringaoleifera* leaves. Studies have shown the strong nutritional potential of leaves from different regions, the results of which have shown the large amount of proteins (> 18%), the quality of amino acids, as well as a large amount of mineral elements (Harimalala Andriambelo, 2021).

However, it is recommended to use the dried *Moringaoleifera* leaves, reduced to powder and not to cook them to keep the nutritional properties (Saint Sauveur and al., 2005). However, this form of use is hampered by its taste and color (Harimalala Andriambelo, 2015).

Thus, in this study we carried out fermentation techniques to remedy the appearance and color of *Moringaoleifera* leaves.

II. MATERIALS AND METHODS

II.1. Materials

The *Moringaoléifera* leaves were harvested in eastern Madagascar, Antsinanana region, on December 2017.

The microorganism used as biomass is the reference strains: *Lactobacillus delbrueckii subsp. Bulgaricus*ATCC 11842, held in the IOI University strain bank.

II.1. Methods

II.1.1 Identification, Confirmation of the strain

Aliquots of 1 mL from conserved strain were spread plated on presolidified de Man, Rogosa, and Sharpe (MRS) agar and incubated at 30°C for 48-72 h. Representative colonies of lactic acid bacteria were randomly picked from countable MRS agar plates. Each bacterial isolate was purified by repeated streak-plating on MRS agar.

Morphological and macroscopic characteristic

Cultural, morphological, physiological and biochemical characterization including microscopic and macroscopic examinations of the various isolates were carried out to the identification of isolates.

Biochemical characteristics

Isolates were identified phenotypically on the basis of biochemical test such as, Catalase, Oxidase, Methyl red test, Nitrate reduction, VP Test, Starch, Casein, Gelatin hydrolysis.

Carbon auxanogram was carried out. It concerns Fructose, lactose, maltose, galactose, arabinose, mannose, xylose, dulcitol, inositol, Mannitol, Raffinose, tréhalose, Rhamnose.

Bacterial isolates were refreshed on MRS broth, and then the broth was incubated at 37°C for 24 h. Turbidity of bacterial suspension was adjusted to 0.1 to 0.5 McFarland standard using spectrophotometer at the absorbance of 600 nm [13].

Each well of Eliza plates was filled with 990 µl of MRS broth with Bromocresol Green (0.04 gm/1000 ml) with pH range of 3.8-5.4.

The first row of wells of the Eliza plates served as a negative control without inoculated with bacterial isolates.

Finally, the plates were incubated at 37°C for 12 to 48 h. The formation of yellow color on the well indicated a positive result for fermentation or acidification, whereas the absence of color change was considered as a negative result.

II.1.2. Inoculation of Inoculation of *Lactobacillus bulgaricus*strain on *Moringa*leaves

25g of powder was taken in a 250 mL flask and mixed in 100ml of Sterile distilled water. The solution was sterilized at 120°C for 20 min.

For all the strains of *Lactobacillus*, glucose is the most efficient carbon source, so it is used as Substrate.

Thus, glucose was added to the medium. Its initial concentration is 30g / l.The solution was seeded with the isolated *Lactobacillus* strains. The concentration of the biomass is Xo = 1.104 cells per ml. The substrate consumption kinetics and the biomass growth kinetics were followed by measuring the optical density at 600nm until the substrate was exhausted.

The ability of lactobacilli to reduce the color of *Moringa* was monitored by measuring chromacity.

The purpose of this spectrophotometric method is to define the process of measuring andcalculating the chromatic characteristics of *Moringa* leaves.
Spectrophotometer to carry out transmittance measurements at a wavelength of between 300 and 800 nm, with illuminant D65 and observer placed at 10º. Use apparatus with a resolution equal to or higher than 5 nm and, where possible, with scan.
Select the pair of cuvettes for the spectrophotometric reading,ensuring that the upper measurement limit within the linear range of the spectrophotometer is not exceeded.
After obtaining and preparing the sample, measure its transmittance from 380 to 780 nm every 5 nm, using distilled wateras a reference in a cuvette with the same optical thickness, in order to establish the base line or the white line. Choose illuminant D65 and observer 10º.
The spectrophotometer must be connected to a computer programme to facilitate the calculation of the colorimetric coordinates (Clarity L*) andtheir derived magnitudes (chroma C* and tone H*), and chromacity [(a*, b*) or (C*, H*)] using the appropriate mathematical algorithms.

A nutritional analysis of the product after fermentation was carried out. Thus, the content of total proteins and polyphenols were determined.

Indeed, fermentation must not reduce these contents, because *Moringa* leaves are exploited for their high contents.

III. RESULTS

Confirmation test

After confirmation of the morphological, cultural and biochemical characters of the strain used, this is the species: *Lactobacillus delbrueckii subsp. bulgaricus*.

Lactobacillus delbrueckii subsp. bulgaricus (until 2014 known as *Lactobacillus bulgaricus*) is one of over 200 published species in the Lactobacillus genome complex (LGC) and is the main bacterium used for the production of yogurt. It also plays a crucial role in the ripening of some cheeses, as well as in other processes involving naturally fermented products. It is defined as homofermentive lactic acid bacteria due to lactic acid being the single end product of its carbohydrate digestion. It is also considered a probiotic.

That are live microorganisms promoted with claims that they provide health benefits when consumed, generally by improving or restoring the microbiome.

Lactobacillus is rod shaped with rounded ends of Gram-positive, aerotolerant anaerobes or microaerophilic, rod-shaped, non-spore-forming bacteria.

Carbohydrates fermented by *L. bulgaricus* (90% or more strains) are fructose, glucose, and lactose. Lactic acid is the major product of fermentation; however, secondary products, such as acetaldehyde, acetone, acetoin, and diacetyl, also can be produced in very low concentrations.

In lactic acid bacteria that do not possess superoxide dismutase, the dismutation of superoxide normally is catalyzed by internally accumulated manganese. *Lactobacillus bulgaricus*, however, has a low capacity to scavenge O_2^- because it does not have superoxide dismutase or high levels of Mn (II) and it is sensitive to O_2 (the ability to grow aerobically must be distinguished from the ability to survive exposure to O_2).

Fermentation

The following table shows the variation of the DO and the concentration of residual glucose during fermentation.

Table 1: Biomass growth kinetics (Lactobacillus bulgaricus) and substrate consumption kinetics (Glucose).

	T0	T6	T12	T18	T24	T48
DO 600nm	0.08	0.12	0.15	0.19	0.18	0.17
S g/l	30	22.5	10.1	2.04	0.04	0.01

According to this table, the bacterial concentration increases during the experiment. DO increases from 0.08 to 0.18 until T18. However, after 18 hours of culture, a decrease in the concentration of viable cells, shown by the decrease in the OD is noted.

This is explained by the depletion of substrates, and possibly the accumulation of metabolism by-products, toxic to biomass.

A decrease in the chromacity of the reaction medium was marked. Thus, the biomass (strain of *Lactobacillus bulgaricus*) therefore has the capacity to considerably discolor the leaves of *Moringaoleifera.*

Table 2 :L,a,b value at T0 and T48 hours

Time (h)	0	48
L	59	58.83
a	-7.97	-2.9
b	34	33.53

The values of (L, a, b) placed on the chromacity diagram show that the color of the fermented powder falls within the region of (white, green, yellow). A lightening of the product is thus obtained. This

parameter could be exploited to improve its visual appearance. Indeed, a visual comparison of unfermented and fermented *Moringaoleifera* leaf powder shows a difference in color in green.

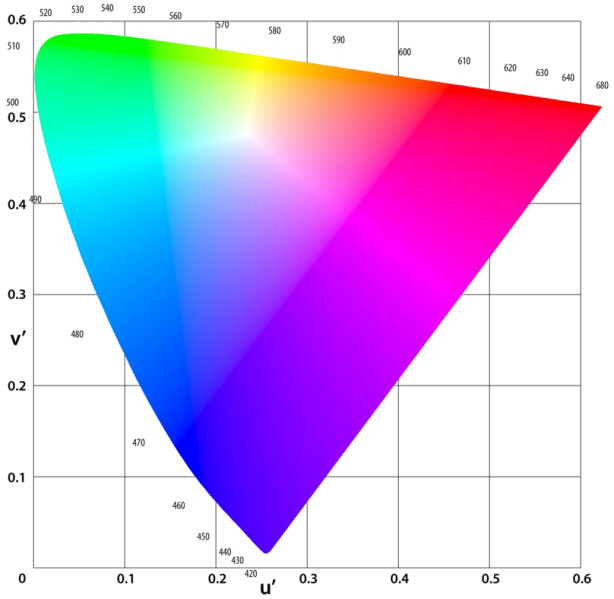


Figure 1: Chromacity diagram

Nutritional analysis

The following table shows the total protein and polyphenol contents before and after fermentation.

Table 3: Total protein and polyphenol content at T0 and T48.

	T0	T48
Proteins %	3.240	4.980
Polyphénols %	21.359	8.342

An increase in protein content was noted. It went from 3.240% to 4.980%. This can be explained by the increase in Biomass in the medium. A large number of microorganisms are an important source of protein. They are exploited industrially during the production of POUCs (Tsirinirindravo and al, 2018).

However, a considerable decrease in the polyphenol concentration was noted: it went from 21.359% to 8.342% in 48 hours. This can be explained by the presence of enzymes such as polyphenol oxidases and peroxidases. These enzymes are produced by bacteria or present in food, and they hydrolyze phenolic compounds (Tsirinirindravo and al, 2018)

REFERENCES :

[1.] Banque mondiale, 2018. Une nouvelle approche évolutive pour mieux lutter contre les retards de croissance.

[2.] HARIMALALA ANDRIAMBELO, 2014. Nutritional quality of fruit pastes enriched with *Moringaoleifera* leaves. In International Journal of Applied Science and Technology. Vol4, N°5, pp163-175.

[3.] HARIMALALA ANDRIAMBELO, 2015. Enrichissement protéique des pâtes de fruits par des feuilles de *Moringaoleifera*. Thèse doctorat. Université d'Antananarivo.

[4.] HARIMALALA ANDRIAMBELO, 2021. Valorization of *Moringaoleifera* leaves by incorporation in tamarin (*Tamarindusindica*) and banana (*Musa sativa*) pastes.

[5.] SAINT SAUVEURA., BROIN M. 2005. *Moringa* news/ Moringa association of Ghana. Produire et transformer les feuilles de *Moringaoleifera*. 36p.

[6.] PNAN III, 2017/2021. La nutrition, garant d'un capital humain pour un développement social et économique durable. 96p.

[7.] PAM, INSTAT, 2014. Analyse globale de la sécurité alimentaire et nutritionnelle et de la vulnérabilité (AGSANV). 96p.

[8.] UNICEF, 2017. Abrégé du plan d'investissement pour la nutrition à Madagascar. 16p.

[9.] TSIRINIRINDRAVO HL, RAFANOMEZANTSOA FM, RANDRIANIERENANA LA, ANDRIANARISOA B, RAHERIMANDIMBY M. Valorisation des graines *d'Hyphaenecoriacea* en boisson alcoolisée. Communication lors des Journées QualiReg 2016. 5eme rencontre de l'Agroalimentaire en Océan Indien « La qualité et l'innovation au service du développement des filières agroalimentaire de l'Océan Indien. Saint Pierre, La Réunion.

[10.] TSIRINIRINDRAVO H.L, MENDES D.S.R., LARROQUE M. Antibacterial effects of probiotics against savage and multi resistant bacteria. International Journal of Food Microbiology 274 (2018) 71-79.

[11.] TSIRINIRINDRAVO H.L**,** RABETSIMIALONA HM, Valorisation de la paille de riz (*Orizasativa)* en vue de la production d'éthanol. Terre d'Espoir. N° 7, 3ème trimestre : juin 2014.

International Journal of Innovation Engineering and Science Research
(ISSN: 2581-4591)
www.ijiesr.com

Antibiotic residues in broilers sold in Antananarivo, capital of Madagascar, in 2019

RAJAOBELINJATOVO Nirinarisoa Patricia[2], HARIMALALA Andriambelo Nirina[1,3], TSIRINIRINDRAVO Herisetra Lalaina[2,3], ANDRIANARISOA Blandine[2], RANDRIAMPARANY Tantely[4], RANDRIAMIARISOANDRAIBE Heritiana[2], ANDRIAMADY Hasinarimanana[2].

[1] *Laboratory of Biochemistry Applied to Food Sciences and Nutrition. Faculty of Sciences, University of Antananarivo*

[2] *Laboratory of Biotechnology. Faculty of Sciences, University of Antananarivo*

[3] *Indian Ocean Islands University, Madagascar, Mauritius*

[4] *Unité Sérologie et Virologie au Laboratoire National de Diagnostic Vétérinaire du Ministère de l'Agriculture et de l'Elevage*

RESUME

Breeding is a predominant and profitable activity in Madagascar. Currently, the poultry sector totals around 35 million head of poultry, according to the FAO. Intensive breeding is the most common form, but breeders resort to the use of feed and veterinary products to speed up the rate of production, which accentuates the presence of antibiotic residues in meats. They train several risks for public health. The objective of this study is to find and / or confirm contamination via the presence of antibiotic residues in broilers.

Surveys of breeders in the capital were carried out as well as samples from a slaughterhouse and butcher shops. Also, 163 samples were taken, including 58 and 105 respectively in the Itaosy slaughterhouse and in the butcher's shops. The samples were then analyzed at the National Veterinary Diagnostic Laboratory using the "Rapid test for the presumptive detection of antibiotic residues" method, certified by AFNOR. Surveys of breeders have shown that no training or monitoring of veterinarians is allocated to them, and good breeding practices are not respected. Analyzes carried out revealed the presence of antibiotic residues in 12 samples out of 163, that is a rate of 7.36%.

Keywords: antibiotic residues; broiler meat; poultry farming, slaughterhouse; Antananarivo

I. INTRODUCTION

Madagascar is an agricultural country where livestock occupies an important place in cultural, social and economic life and plays an important role in food security and the fight against poverty. Indeed, being one of the main agricultural activities in Madagascar, 71.70% of rural households practice animal husbandry and thus provide 25% of rural income. The poultry industry has become a very fashionable speculation, and is growing in importance. According to statistics published by the United Nations Food Fund (FAO), the poultry herd in Madagascar exceeds 35 million head, about 86% of these animals come from village poultry farming.

Two types of breeding can be distinguished: on the one hand, traditional poultry farming for the production of standard "Akohogasy" chicken and on the other hand, commercial or modern poultry farming which generally includes laying hens and broilers. .

Particularly, the production of short-cycle animals is one of the avenues used to achieve food self-sufficiency in meat and eggs due to low production costs and low prices of products resulting from this speculation. For Madagascar, the average annual production of broiler chickens per individual is 0.28 kg, or one fiftieth of the individual world production. The Malagasy consume 20 eggs per capita per year and 2.37 kg of broiler meat per year per capita

However, breeders resort to the use of feed and veterinary products to speed up the rate of production, which increases the presence of antibiotic residues in meats. They pose several risks to public health.

The objective of this study is to search for the presence of antibiotic residues in broilers sold on the Antananarivo market.

II. MATERIALS AND METHODS

Materials

Surveys of breeders in the capital were carried out as well as samples from a slaughterhouse and butcher shops. Also, 163 samples were taken, including 58 and 105 respectively in the Itaosy slaughterhouse and in the butcher's shops.

Methods

Poultry tissue samples were used for testing. Both types were submitted for regulatory analysis. These were received frozen and analyzed promptly or held frozen and analyzed within 3 days after receipt.

They wereshipped under refrigeration on the same day for analysis by the Charm *Bacillus stearothermophilus*disc assay (BsDA) as well as for analysis of total viable bacteria counts and coliform bacteria counts.

The day following the day of sampling, each refrigerated sample was analyzed for b-lactam residues by the antibiotic residue screening tests. These selected rapid screening tests represented a variety of analytical principles to assay b-lactam antibiotic residues on food. All screening tests were run simultaneously for each sample. The tests were conducted according to the recommendations of the manufacturers except that positive results were not repeated. Sample was collected from a control cow that had not been treated with an antibiotic within 30 days, and negative and positive control samples were assayed with each test for the 3 days of analyses. Penicillin-G sodium (1647 U/mg) was brought to a final concentration of 10 ppb for the positive control sample. Positive and negative control samples were prepared fresh daily for each test day. A visual detection of color change was done.

For this screening test, the selectivity rate (defined as the rate of truly negative samples that were found to be negative by the assay) and a 95% confidence interval were calculated. The selectivity rate was calculated as the number of truly negative assays divided by the total number of samples that were analyzed. The selectivity rate could be converted tothe false-positive rate by subtracting the selectivityrate from 1.0. Using logistic regression, factors associated with the rate of false-positive outcomes were evaluated for each test that had more than one false-positive outcome.

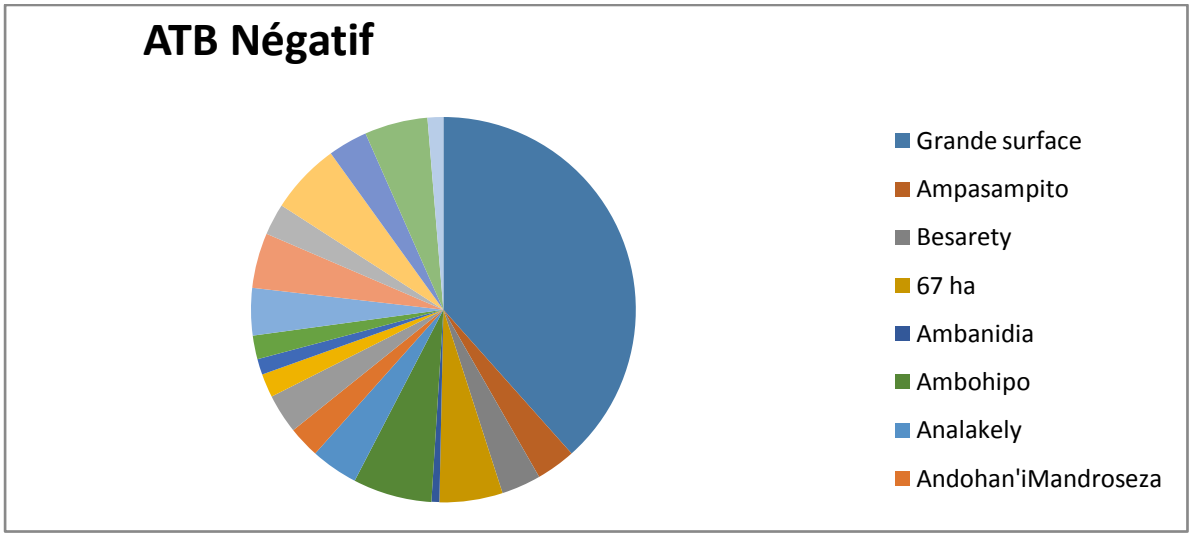
III. RESULTS

Surveys of breeders have shown that no training or monitoring of veterinarians is allocated to them, and good breeding practices are not respected.

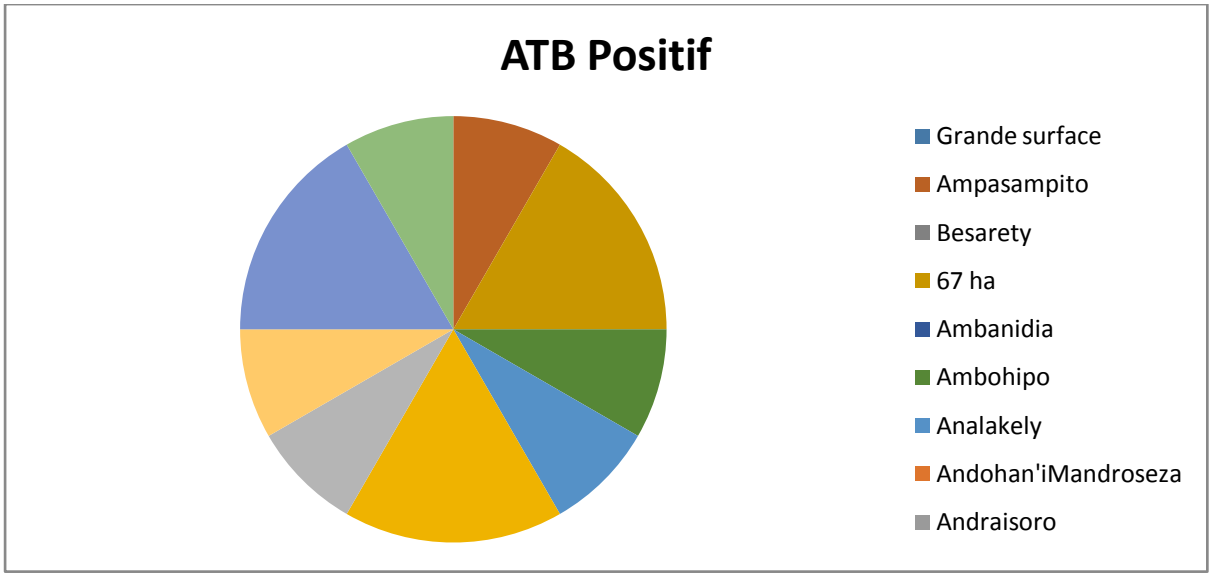
Table 1 and Figures 1 and 2 show the number of samples collected, which tested positive and which tested negative.

Table1 :Breakdown of sampling results

	Localisation marché	**ATB Négatif**	**ATB Positif**	**Effectifs**
Abattoir	Grande surface	58	0	58
Boucherie	Ampasampito	5	1	6
	Besarety	5	0	5
	67 ha	8	2	10
	Ambanidia	1	0	1
	Ambohipo	10	1	11
	Analakely	6	1	7
	Andohan'iMandroseza	4	0	4
	Andraisoro	5	0	5
	Andravoahangy	3	2	5
	Ankadidramamy	2	0	2
	Ankadifotsy	3	0	3
	Ankatso	6	0	6
	Anosizato	7	0	7
	Imeritsiatosika	4	1	5
	Isotry	9	1	10
	Itaosy	5	2	7
	Mahazo	8	1	9
	Tsimbazaza	2	0	2
TOTAL		**151**	**12**	**163**



Negative sample results



Positive sample results

Analyses carried out revealed the presence of antibiotic residues in 12 samples out of 163, ie a rate of 7.36%.

These results show that the presence of antibiotics in chickens was detected in butcher shops in municipal markets and not in products from supermarkets.

Table 2: Summary results of the laboratory analysis

Résultats	Nombre de prélèvements	Pourcentage (%)
POSITIF	12	7.36
NEGATIF	151	92.64

The use of antibiotic residue screening tests andthe implementation of good management practiceshave been shown to reduce the occurrence of antibiotic residues on poultry.

In the present study, the selectivity rates of thescreening assays were calculated using results fromthe poultry that had a high probability of no antibiotic drug residue. To calculate trueselectivity rates, the concentration of the antibiotic using quantitative analytical methodology isneeded.

Antibiotic screening assays that are based on theinhibition of microbial growth are sensitive methods,but, because they are nonspecific for the antibiotic,these assays are affected by naturally occurring antimicrobial components

The study confirms the misuses and non-compliance of the withdrawal period between the administration of antibiotic in animal and its slaughter. Therefore, control of antibiotic residues should be a future concern for both producers and processor in order to protect health's consumers.

The high level of contamination cases recorded in our poultry meatsamples canprobably be explained, by the massive use, uncontrolled and prolonged antibiotics in poultryfarms to treat and prevent against specific diseases, both in the therapeutic settingrecommended by the veterinarian or but in the case of self-medication, but also by thedisrespect of withdrawal periods between the administration of antibiotics in animal and earlyslaughter, motivated by a greater demand for this product in religious holidays, like Christmasin other countries. According to a survey

conductedin Ivory Coast on the use of antibiotics in the semi-industrial poultry farms, 73% of them donot seek veterinary and self-medicate (Ouattara and al, 2013).
The same observation was reported by Donkor et al. (2011) on the determination ofcontamination factors of animal products by antibiotics. Note that self-medication is bannedin developed countries. According to the French agency for Food Safety (AFSSA), it can bethe cause of the increase in multidrug-resistant pathogens. The same author points out thatwaiting time in order to ensure the health's consumer are not met in 51% of the farms visited.
Several factors may influence the use of antibiotics in poultry production. In France,according to a study on the use of antibiotics in pig production, poultry and rabbit, theinfluence of the breeding on the use of antibiotics probably finds its explanation from theintrinsic characteristics of the farm (buildings, geographical location), the practices of thebreeder. Indeed, the results of this survey show that biosecurity measures and the mastery ofmajor diseases are essential to the reduction of use (Chauvin and al, 2012).

REFERENCES

[1.] MINISTERAN'NY FIOMPIANA, 2010. *NyTsarahoFantatraLaharanaFaha 3 « FiompianaManara-penitra, Fanohitrahoan'nyToe-karena* », 16p

[2.] FAO, 2015, Rapport spécial « *Mission d'évaluation des récoltes et de la sécurité alimentaire à Madagascar*. Mission FAO/PAM », 77p

[3.] MAEP, UPDR., Juillet 2004, « Filière Aviculture Moderne Fiche 208 » 11p ;

[4.] N'KAYA TOBI., 2004. *Etude comparative de la présence des résidus d'antibiotiques dans les muscles de la cuisse et du bréchet du poulet de chair dans la région de Dakar*, Faculté de Médecine, de Pharmacie et d'Odonto-Stomatologie de Dakar pour obtenir le grade de Docteur Vétérinaire, 92p

[5.] ANDRIANIRINA S.B.A., Octobre 2017, Analyse technico-économique de la mise en place d'un élevage fermier de poule de race locale, Mémoire pour l'obtention du diplôme d'Ingéniorat en Agronomie, Master en Sciences Agronomiques et Environnementales, 62p

[6.] FAO, Octobre 2015. Rapport spécial « Mission d'évaluation des récoltes et de la sécurité alimentaire à Madagascar. Mission FAO/PAM », 77p

[7.] RAKOTOBE H., 21 Décembre 2020, Madagascar: Aviculture - La filière « poulet gasy » sous exploitée, Express Madagascar

[8.] RAKOTONDRABE N., Avril 2013, Impacts socio-économiques des maladies aviaires prioritaires a Madagascar, Thèse de Doctorat en Médecine Vétérinaire, 88p

[9.] TSIRINIRINDRAVOHL, RANDRIANIERENANA LA,ANDRIANARISOA B, RAHERIMANDIMBYM, RANDRIANANTOANDRO HH, RAZAFINJATOVODN, DE PERCIN Guilhem, BOZZI Pierluigi. Aspects épidémio-cliniques des toxi-infections alimentaires collectives (TIAC) dans la région Analamanga, cas de janvier à juin 2015. Journées QualiReg 2016. 5eme rencontre de l'Agroalimentaire en Océan Indien « La qualité et l'innovation au service du développement des filières agroalimentaire de l'Océan Indien. Saint Pierre, La Réunion.

[10.] THARMARAJ A, HANSON O., FORSTER A., TSIRINIRINDRAVO H.L, MENDES D.S.R., LARROQUE M. Antibacterial effects of probiotics against savage and multi resistant bacteria. International Journal of Food Microbiology 274 (2018) 71-79.

[11.] TSIRINIRINDRAVO H.L.,RANDRIANIERENANA L.A.,ANDRIANARISOA B., RAHERIMANDIMBY M., RANDRIANANTOANDRO H.H., De PERCIN G., PIERLUIGI B. and Forster A. Molecular Identification of *Salmonella typhimurium* from chicken sold in Analamanga Region, Madagascar. Short communication. International Food research Journal. 24 (6) : 2716- 2719. Décembre 2017.

International Journal of Innovation Engineering and Science Research
(ISSN: 2581-4591)
www.ijiesr.com

Hygienic quality of melting salads sold in Antananarivo, capital of Madagascar, in 2018

TSIRINIRINDRAVO H.L.[1,2], HARIMALALA ANDRIAMBELO N [1,2], ANDRIANARISOA B. [1], RAHERIMANDIMBY M. [1], RAKOTOARISOA M.T. [1,2], DE PERCIN G. [2,3], DELANDES X.[3], PIERLUIGI B[4].

1. *Mention Biochimie fondamentale et appliquée, Faculté des Sciences d'Antananarivo, Madagascar*
2. *Indian Ocean Islands University, Madagascar, Mauritius*
3. *Ecole spéciale ESTPI, Paris*
4. *International University Network on Cultural and Biological Diversity (IUNCBD), Italie*
5. *Faculté de Pharmacie de Montpellier, France*

ABSTRACT

Street foods are foods and beverages sold on the streets or other similar public places (FAO, 1990). They are one of the main income-generating activities for women, promote local products, and express the culinary art of the country.However, they are very often linked and involved in cases of food poisoning. Among the best-selling and most beloved street foods in Madagascar are compounds. Thus, the hygienic quality of the compounds sold in the markets of Antananarivo, capital of Madagascar, was studied, from January to December 2018.

The germs of alterations, the germs indicative of faecal contamination, and indicators of human contamination have been counted. Pathogenic germs were sought, according to international standards ISO and AFNOR.The samples analysed were of bad hygienic quality. The TABs, the contamination indicator germs were all at levels above the reference criterion.

A high level of Total Aerobic Bacteria TAB (>10^6ufc/g), Enterobacteriaceae (>10^2/g) and *Escherichia coli* β glucuronidase+ is noted. The values of the Total Aerobic Bacteria count was 0.1x10^6-4.8x10^6cfu/g. Enterobacteriaceae count range from 0.4x10^2 to 1.9x10^2cfu/g and *Escherichia coli* count range from 0.04x10^2cfu/g. to 0.19 x10^2cfu/g. Pathogen bacteria as *Salmonella* was present in melting saladssamples. *Bacillus cereus* count range from 0,1x10^2 to 1,5x10^2cfu/g. *Campylobacter jejuni were* absent on all samples.

Keywords : salads samples, aliments de rue, qualité hygiénique, Antananarivo, Madagascar

I. INTRODUCTION

According to FAO, street foods are foods and beverages sold on the streets or other similar public places (FAO, 1990). Its expansion is mainly linked to urbanization and the multiple constraints associated with it such as poverty, unemployment, distance from workplaces from home, etc. Street foods allow more than 80% of urban populations to satisfy their needs. They are one of the main income-generating activities for women, promote local products, express the culinary art of the country. In addition, they generate income allowing many households to meet their needs (Delisle, 1991).

These street foods can be characteristic of a country or a region: kobandravina, mofogasy, ramanonaka in Madagascar, Chipsi Mayai (a kind of potato omelet) in Tanzania, Baozi (breads baked in steam) in China or Pempek (Fish cakes) in Malaysia or Indonesia.

The "processor-seller" ensures both the production (at home or at the point of sale) and the marketing of food. Unfortunately, many cases of food poisoning or foodborne illness are directly related to these street foods.

In Morocco, in 2016, 5,991 cases of poisoning related to street food were recorded, including 78 deaths (WHO, 2001).

In Antohombe Rural Commune, Betafo District, Madagascar, 70 people suffered from food poisoning on December 23, 2016. Characteristic symptoms were diarrhoea, severe abdominal pain, requiring evacuation to Antsirabe hospital. The food in question was a mixed dish in the same tavern (Express de Madagascar, December 2016).

Foods sold on the outskirts of city streets therefore constitute a major public health problem due to the multiplicity and diversity of the microbial flora they carry.Among these street foods, figure the "mixed salad", which is a variant of pasta salad, appreciated and eaten by many populations in the big cities of Madagascar, especially Antananarivo. Thus, a study was carried out to determine the sanitary quality of foods and street foods in Madagascar. This study was undertaken in 2018 in Antananarivo (urban and suburban area), capital of Madagascar.

II. MATERIALS AND METHODS

Materials

137 samples constituted our study material. They were collected from January to December 2018 in Antananarivo, capital of Madagascar. Table 1 show the number of samplestaken and analysed.

Table 1: Characteristics of the samples analyzed.

	Samples from Urban community	Samples from suburban commune	**Total samples**	period
Mixed salad	87	50	137	2018

Methods

The methods used during this study follow international standards: ISO and AFNOR.Given the size of the population studied, several types of sampling were undertaken, depending on the type of foodstuff analysed, the target populations (type of consumer, density per population).Thus, during sampling, we make sure that by studying a small group (sample) chosen at random, we obtain data on the desired variables of a group of larger dimensions (population), following which one can reason by inference about the behaviour of these variables in the population. Several parameters must first be defined: the population, the sampling frame, the sampling unit and the type of sampling (WHO, 2004).

Sample preparations and analysis

Serial dilution

Twenty-five grams (25 g) of each sample was mixed carefully with 225 ml of buffered peptone water. This mixture was homogenized and shacked to obtain a uniform mixture. One ml of the homogenized food sample was aseptically transferred into a test tube containing 9 ml sterile distilled water. Five dilutions of the homogenates were prepared in conformity with the recommendation of the norm ISO 6887.

Enumeration of Total Aerobic Bacteria

Plate Count Agar (PCA) (Oxoid Ltd, United Kingdom) was used for Total Aerobic Bacteria and was done in conformity with the recommendation of the norm ISO 4833.

Enumeration of *Bacillus cereus*

The recommendation of the norm ISO 7932 was used. 1 ml of the dilution of each food sample was plated onto polymyxin-pyruvate-egg yolk mannitol-bromothymol blue agar plates (Oxoid), which were air dried and incubated at 37°C for 24 to 48 h. Blue colonies with blue zones were subjected to appropriate biochemical tests.

Detection of *Salmonella* spp.

*Salmonella spp*was detected with the recommendation of the norm ISO 6579. Twenty-five grams (25 g) of each sample was mixed with 225 ml of buffered peptone water and incubated at 37^{o}C for 16 h. One ml of this culture was pipetted into 10 ml of Rappaport-Vasilliadis Soya broth (RVS). These were incubated at 41^{o}C for 24 h. The culture was streaked into Hektoen Agar. The agar plate were incubated at 37^{o}C for 24 h. The plate were examined for typical green blue colonies of *Salmonella*.

Detection of *Escherichia coli β* glucuronidase +

1 ml of the dilution of each food sample was plated onto Eosin Methylen Blue Agar Medium and incubated at 44°C for 24h to 48 h. Black green metallic colonies were subjected to appropriate biochemical tests according to the norm ISO 16649.

Detection of *Campylobacter jejuni*

25 g of the food sample was mixed with 100 ml Preston broth (Oxoid) and homogenized for 2 min. The enrichment broth was incubated at 42°C for 24 to 48 h. The broth culture was streaked onto Skirrow's agar plates (Oxoid), which were then incubated at 42°C. Colonies were Gram stained and tested for oxidase reaction. Suspect colonies were subjected to appropriate biochemical tests, done in conformity with the recommendation of the norm ISO 10272: 2006.

III. RESULTS

As shown in Table 2, melting salads was found to be contaminated. A high level of Total Aerobic Bacteria TAB (>10^{6}ufc/g), Enterobacteriaceae (>10^{2}/g) and *Escherichia coli* β glucuronidase + is noted.

The values of the Total Aerobic Bacteria count was 0.1x10^{6}- 4.8x10^{6}cfu/g. Enterobacteriaceae count range from 0.4x10^{2} to 1.9x10^{2}cfu/g and *Escherichia coli* count range from 0.04x10^{2}cfu/g. to 0.19 x10^{2}cfu/g.

Pathogen bacteria as *Salmonella* was present in melting saladssamples. *Bacillus cereus* count range from 0,1x10^{2} to 1,5x10^{2}cfu/g. *Campylobacter jejuni,* was absent on all samples.

Table 2: Microbiological assessment of melting salads samples collected in Antananarivo market on 2018.

Microorganismsɳ	TAB.10^{6}/g	Ent. 10^{2}/g	E.C.BG+ 10^{2}/g	SLM/g	CAMP/g	BC10^{2}/g
Melting salads	4,854	1,927	1,259	12,49	A	1,445

TAB : Total AerobicBacteria, Ent : Enterobacteriaceae, E.C.BG + : *Eschercichia coli βglucuronidase* +, SLM : *Salmonella spp,* CAMP : *Campylobacterjejuni,* BC : *Bacillus cereus,* A: Absent

IV. DISCUSSION

The result of these different analysis carried out on street foods: melting salads samples revealed that all samples collected were contaminated by microorganisms.

This is due to the inadequate personnel hygiene of vendors, the bad condition at which it produced, and using raw materials of poor quality or the fact that they were exposed in an open air because there are several microorganisms (beneficial or pathogen) that we can find in environment.

Salmonella species belongs to the family of Enterobacteriaceae. It is present in melting salads. It confirms study led on 2016, which showed especially the implication of melting salads and skewers for several cases of Typhoid fever in Madagascar.

Escherichia coli is a bacteria that normally lives in the intestines of people and animals. There are many different types of *E. coli*. Most E. coli are found naturally in intestines and play an important role in helping our bodies digest food. However, a few types of *E. coli* can cause diarrhoea and other illnesses when swallowed.

A previous study led in the Urban Commune of Antananarivo, Health Ministry and WHO shows that this species is the first responsible for foodborne disease in Antananarivo on 2016.

In 2015, Tsirinirindravo and al found that melting salads was the first food associated with foodborne illness in Antananarivo. However, it is very appreciated by consumers.

The presence of *E. coli* and other *Enterobacteria* is an indication of possible faecal contamination of food, water or food workers and poor hygienic processing practices (Little et al., 1998; Tambekar et al., 2007). The presence of *S. aureus* is largely as a result of human contact and this suggests poor hygiene practices of the operators since this organism is a normal flora of the skin and nasal passage (Garret, 1988; Nichols et al., 1999).

Bacillus cereus is present in highly concentration in melting salads. Their microbial load are superior to the bacteriological criteria. It could be due to the characteristic of this bacteria to metabolize starch while these foods are made of starch.The occurrence of *Bacillus cereus* in the foods could be due to the fact that they are spore formers. These heat-resistant spores may have survived processing while vegetative cells were eliminated.

Contamination of foods could have resulted from inappropriate processing, incomplete heating, or secondary contamination via contact with contaminated equipment and utensils.

Education of the food handlers/food vendors on food safety practices and a close and stringent supervision of ready-to-eat foods sold in the schools should be carried out by relevant authorities to prevent foodborne illness.

These diseases are seen as a pervasive, permanent problem that can lead to morbidity and, occasionally, to mortality. Foodborne diseases are increasing worldwide, particularly in the developing countries, due to neglect of personal hygiene and food hygiene.

Foodborne illnesses pose a threat to international public health safety and economic development. With the increasing amount of trade, travel and immigration, the rate at which dangerous contaminants and pathogens pass through the borders has also risen.While experts on food safety and health have determined that millions of foodborne disease cases are reported every year, the actual numbers are clouded by uncertainty, as most cases go unreported. Furthermore, foodborne diseases are difficult to diagnose, since they have various symptoms, including fatigue, chills, mild fever, vertigo, upset stomach, dehydration caused by diarrhoea, severe cramps and, in some cases, even death.

In many of the reported cases, foods prepared outside of the home are the primary cause of foodborne diseases, though it is not uncommon for home-made foods to also cause diseases. In fact, most foodborne diseases can be prevented if the regulations governing food safety were complied with, from production stages to consumption.Improper heating of the food, such as undercooking, re-heating and waiting in the heat, or improper cooling of the food account for 44% of the foodborne illnesses. Inadequate preparation and improper cooking practices, such as those involving cross-contamination, insufficient processing, poor hygiene and the re-use of leftovers, are responsible for causing 14% of these diseases.

REFERENCES

[1.] BIBEK R., Fundamental Food Microbiology 2nd éd. The CRC Press Ltd Washington, DC 2001, 56-90).

[2.] CHUKWUEMEKA, NNENNE I.I. and CHRISTIAN U.I., Bacteriological quality of foods and water sold by vendors and in restaurants in Nsuka, Enugu State, Nigeria: A comparative study of three Microbiological methods, Journal of Heath Population and Nutrition, 29(6), 2011, 560-566.

[3.] EUN-JIN L., CHOI, J., GROISMAN, E.A. 2014. Control of a *Salmonella* virulence operon by proline-charged tRNApro. Proc. Natl. Acad. Sci. USA 111, 3140–3145.

[4.] INTERNATIONAL STANDARD ORGANISATION. Microbiologie des aliments. Méthode horizontale pour le dénombrement des micro-organismes. Technique de comptage des colonies à 30 degrés. ISO 4833:2003.

[5.] INTERNATIONAL STANDARD ORGANISATION. Microbiologie des aliments. Méthode horizontale pour la recherche des *Salmonella spp*. ISO 6579:2002.

[6.] INTERNATIONAL STANDARD ORGANISATION. Microbiologie des aliments. Méthode horizontale pour le dénombrement de *Bacillus cereus* présomptifs. Technique par comptage des colonies à 30 degrés C. ISO 7932:2004.

[7.] INTERNATIONAL STANDARD ORGANISATION. Microbiologie des aliments. Méthode horizontale pour la recherche et le dénombrement de *Campylobacterspp*. ISO 10272:2006

[8.] INTERNATIONAL STANDARD ORGANISATION. Microbiologie des aliments. Méthode horizontale pour le dénombrement des *Escherichia coli* bêta-glucuronidase positive. ISO 16649 :2001.

[9.] INTERNATIONAL STANDARD ORGANISATION. Microbiologie des aliments. Méthode horizontale pour la recherche des *Escherichia coli* O157. ISO 16654:2001.

[10.] FOOD AND AGRICULTURAL ORGANIZATION. 1997 .Agriculture food and Nutrition for Africa. A resource book for teachers of Agriculture, Rome. 12 (3):25-29.

[11.] FOOD AND AGRICULTURE ORGANIZATION FAO.1992. *Escherichia coli* and other coliforms. Manual of food quality control. Rev.1- Microbiological Analysis, Food and Agriculture Organization of the United Nation, Rome, Italy, Chap. 3PP, 13-26.

[12.] FOOD AND DRUG ADMINISTRATION "FDA" 2001. *Staphylococcus aureus*. Bacteriological analytical manual .8th Ed. Chapter12. Gaithersburg, p.562.

[13.] FRANZ E., BRUGGEN A. H. 2008. Ecology of *E. coli* 0157:H7 and *Salmonella enterica* in the Primary Vegetable Production Chain." Crit. Rev. Microbiol. 34 (3-4): 143-161.

[14.] GILBERT R., DE LOUVOIS J., DONOVAN T., LITTLE C., NYE K., RIBEIRO C. D., RICHARDS J., ROBERTS D., BOLTON F. B. 2000. Guidelines for the microbiological quality of ready-to-eat foods sampled at point of sale. Commun. Dis. Public Health 3:163–167.

[15.] LARPENT J-P., LARPENT-GOURGAUD M. Mémento technique de microbiologie, 3éd. Londres, New York, Paris. Lavoisier, 1997 : 1039 p.

[16.] PRESCOTT L.M., KLEIN D.A. (2008). Pathogenic Organisms. Microbiology, 7th éd McGrew hill, New York. pp 340, ISN 978-0-07-110231-5.

[17.] TAMBEKARAND D.H., MUNDHADA R.H. Bacteriological quality of salad vegetables sold in Amravati City (India), Journal of Biological Sciences, vol.6, no.1, pp.28–30, 2006.

[18.] TINKER I. (1997). Street Foods, Urban Food and Employment in developing Countries. Oxford. University Press, New York, 1997. pp 124-126

[19.] TOMOYASU, T., YAMANAKA, K., MURATA, K., SUZAKI, T., BOULOC, P., KATO, A., NIKI, H., HIRAGA, S., OGURA, T. 1993. Topology and subcellular localization of FtsH protein in *Escherichia coli*. J. Bacteriol. 175, 1352–1357.

[20.] TSIRINIRINDRAVO H. L., RANDRIANIERENANA L. A., ANDRIANARISOA B., RAHERIMANDIMBY M., RANDRIANANTOANDRO H. H., RAZAFINJATOVO D. N., DE PERCIN G., PIERLUIGI B.Aspects épidémio-cliniques des toxi-infections alimentaires collectives (TIAC) dans la région Analamanga, cas de janvier à juin 2015. Communication lors des Journées QualiReg 2016. 5eme rencontre de l'Agroalimentaire en Océan Indien « La qualité et l'innovation au service du développement des filières agroalimentaire de l'Océan Indien. Saint Pierre, La Réunion.

[21.] TSIRINIRINDRAVO H.L., ANDRIANARISOA B. Société Française de Microbiologie VIIIe Congrès National Marseille 2010, carrefour des microbiologies du Nord et du Sud Palais des Congrès, parc Chanot, Marseille SFM MARSEILLE 2010 - ABSTRACT n°039 Programme : activités antibactériennes de l'extrait issu de *Mesanthemumrutenbergianum* (Eriocaulacees). 2, 3 et 4 juin 2010.

[22.] TSIRINIRINDRAVO H. L., RANDRIANIERENANA L. A., ANDRIANARISOA B., RAHERIMANDIMBY M., RANDRIANANTOANDRO H. H., RAZAFINJATOVO D. N., DE PERCIN G., PIERLUIGI B.Espèces de *Salmonella*multi résistantes véhiculées par les aliments de rue à Antananarivo. *Communication lors des Journées QualiReg 2016. 5eme rencontre de l'Agroalimentaire en Océan Indien « La qualité et l'innovation au service du développement des filières agroalimentaire de l'Océan Indien. Saint Pierre, La Réunion.*

[23.] WATARU H., NORIYUKI N. High prevalence of blaCTX-M-14 among genetically diverse *Escherichia coli* recovered from retail raw chicken meat portions in Japan. Journal of Microbiology. August 2018, Volume 56, Issue 8, pp 530–535.

[24.] WORLD HEALTH ORGANIZATION, Food borne diseases; a focus for health education, 53rd world health assembly, Geneva, 2000.

[25.] WORLD HEALTH ORGANISATION (1984). The Role of Food Safety in Health and Development. Technical Report Series 705. Expert Committee on Food Safety, Geneva: WHO: 1-79.

International Journal of Innovation Engineering and Science Research
(ISSN: 2581-4591)
www.ijiesr.com

Sanitary quality of milk sold in Antananarivo, Madagascar on 2018, 2019

TSIRINIRINDRAVO H.L.[1,2], HARIMALALA ANDRIAMBELO N [1,2], RAHERIMANDIMBY M. [1], RAZANAMPARANY L [1], DE PERCIN G. [2,3], BOWLER [2,3], FORSTER A [2,4], DELANDES X.[3], PIERLUIGI B[2,4].

1. *Mention Biochimie fondamentale et appliquée, Faculté des Sciences d'Antananarivo, Madagascar*
2. *Indian Ocean Islands University, Madagascar, Mauritius*
3. *Ecole spéciale ESTPI, Paris*
4. *International University Network on Cultural and Biological Diversity (IUNCBD), Italie*
5. *Faculté de Pharmacie de Montpellier, Montpellier*

ABSTRACT

The present study evaluated the microbiological and sanitary quality of fresh milk sold inAntananarivo, Madagascar. The research was performed between March 2018 to March 2019.One hundred twenty two samples of milk were collected to estimate the populations of mesophylls, psychrotrophic microorganisms, *Staphylococcus aureus*, *Salmonella*, mold and yeast, total coliforms, and *Escherichia coli.* An observational analysis was performed during thecollection, using a checklist to verify the sellers sanitary conditions. A high non conformity index was registered regarding aspects in the checklist. In the microbiological analyses, the number of mesophylls ranged from 7,88 to 14,82 log CFU/g, and those of psychrotrophs ranged from 2,80 to 3,84 log CFU/g. Meanwhile, mold and yeast levels in the samples ranged from 8,06 to 5,54 log CFU/g, *S. Aureus* was detected at levels from 3,24 to 4,94 log CFU/mL, and thetotal coliform counts ranged from 4,48 to 7,18 log CFU/mL. The number of *E.coli*specimensranged from 2, 96 to 5,75 log CFU/mL. Microbial insecurity was noted for commercialized freshmilk, and the need for intervention was indicated.

***Keywords*:**Milk, Antananarivo, Madagascar, Sanitary quality, Microorganisms

I. Introduction

In many cities and towns of developing countries, street food vending is a large source of employment and contributes significantly to households incomes. Street foods are defined by the FAO as ready to-eat food and beverages prepared and or sold by vendors and handlers especially in streets and other similar places for immediate consumption or consumption at a later stage without further processing or preparation. However, it is a major cause of food-transmitted diseases (FTDs) and varioushealth issues [2]. Traditional street-vended food could represent a major risk to public health, due to the unsanitary and unhygienic conditions, including poor infrastructure, improper storage temperature, and poor hygiene among the handlers during commercialization [3]. Fresh milk is among commercialized and consumed foods even though the absence of microbiological contamination cannot be ensured; however, it has social and economic relevance [4]. Informal food vending is a common practice characterized by high microbiological risk, carrying serious health liabilities for consumers [5].

Considering the informal sale of milk and its derivatives, several studies previously identified the main pathogenic microorganisms,namely, *Staphylococcus aureus, Salmonella*spp., *Listeria monocytogenes,* and *Escherichiacoli* [7–10]. Knowledge concerning themicrobiological quality of commercializedfresh milk is valuable because the consumptionof contaminated food may cause FTDs, thus,representing a public health problem. Thepresent study evaluated the microbiological and sanitary quality of Fresh milk sold inAntananarivo, capital city of Madagascar, andverified whether a relationship exists betweenthe commercialization conditions and thereported microbiological data.

II. Materials and Methods

The study was undertaken at 5 market places of Antananarivo. The following places were chosen randomly: 67Ha, Isotry, Andravoahangyambony, Mahamasina, Besarety. One hundred twenty two samples of fresh milk were collected. Samples were collected in March 2014 to March 2017. Samples were collected aseptically, transported in an isothermal container with ice, and maintained under refrigeration until microbiological analyses were conducted at the Laboratory of Microbiology of the Indian Ocean Islands University Madagascar (IOI University Madagascar).

An observational analysis was performed at the time of sample harvesting using a checklist which included questions on the handlers' hygiene and sanitary habits and the commercialization and storage of milk. The temperature of milk was registered immediately after retrieving the samples to verify compliance with the legislation [11, 12]. The microbiological analyses comprised the totalcounts of psychrotrophic microorganisms, mesophylls, mold and yeast, *S.aureus*, total coliforms, and *E.coli*. The pour plate technique was employed for the microbiological analyses of psychrotrophic microorganisms and mesophylls, with plate count agar used as the culture medium. Samples (25ml in total) were obtained from several sites of each specimen and placed in 225 mL sterile flasks containing
0.1% peptonized water, and 1mL of each dilution was transferred to a Petri plate with 25mL of previously heated agar at 43–45◦C. After homogenization and solidification, plates were incubated in a buffer at 7°C for 10 days or at 35◦C for 48h for psychrotrophic microorganisms and mesophylls, respectively.Colonies were counted using a colony counter. The average colony number on each plate wasmultiplied by the corresponding dilution factor, and the result was presented as log UFC/mL.The spread plate method was employed to calculate the mold and yeast counts inSabouraud dextrose agar medium. Plates containing 25mL of culture medium wereprepared and inoculated with 0.1mL of each dilution on the medium surface, and theinoculum was spread carefully. Plates were then incubated and buffer at 24◦C for 48–72h [13].Coliforms were counted using Violet Red Bile Lactose Agar, following the manufacturer'sinstructions. Colonies were counted using a colony counter, in particular, dark blue to violetcolonies were classified as *Escherichia coli*, and red colored colonies as other coliforms. *S.aureus* levels were analysed using international standard methods NF V 08 057 2 with BairdParker Medium. Statistical analysis was performed using SPSS 17, and descriptiveanalysis comprised means and standard deviations for quantitative variables and proportions for qualitative variables. Student's t-test was employed.

III. Results and Discussion

The Workers. This analysis revealed a low index for personal care, as 97, 21% of workers don't follow Good Practice Hygiene GPH. Microbiological Profile of Fresh milk. Thisanalysis revealed high levels of contamination of fresh milk for mesophylls, mold, yeast,*S.aureus*, total coliforms, and *E.coli*(Table 1). This analysis revealed a low index for personalcare, as 97, 21% of workers don't follow Good Practice Hygiene GPH. Moreover, in 2017,Tsirinirindravo et al reported that there a high contamination of some street vended foods inMadagascar, and relationship between quality of these street foods and workers.

Furlaneto-Maia et al. and Chukuezi also reported high non-compliance rates among the food handlers concerning their body care. Inadequacy concerning these factors contributesto increased transmission risks of pathogenicagents via commercialized food. All food

vendors were observed to handle money andfood simultaneously, without washing their hands, jeopardizing proper food handling [21, 22]. Cortese et al. [16] also reported low efficiency for this factor, confirming globalstudies regarding the lack of hygiene among the food handlers. Microorganisms are present onthe hands in substantial.When the food handlers were examined for theiruniforms, all were found without gloves. Thecommercialized milk had a wide range of holesizes which may be related to poor conditions during producing. Meanwhile, Franco and Land graf found that these items are highly efficient concerning the aspects of hygiene and food safety. Allcommercialized milk was stored at roomtemperature even though the technical rules onthe identity and quality of fresh milk stipulatethat milk should be stored at a temperature notexceeding 4◦C during conservation andcommercialization [11]. Storage datarevealedcarelessness regarding the containers in whichthe food was preserved. In fact, 73.3% ofcontainers did not meet the cleanlinessstandards.

The Table 1 has values which exceeded the values reported by Meneses et al. [20], who recorded levels of 8.1 and 6.4 log CFU/g for samples of fresh milk, respectively. High mesophyll levels (Table 1) were also reported by Delamare and *al*. in their analysis ofhomemade milk samples manufactured in Kenya. Specifically, the counts of mesophyllbacteria ranged from 7.91 to 9.47 log CFU/g. Although no normative standards exist atpresent, estimates of such populations are relevant because high levels of mesophyllmicroorganisms in food indicated efficient hygienic and sanitary conditions. Total coliform levels averaged 7.18 log CFU/g in milk samples, respectively. Salotti*andal.* reported that the levels of these microorganisms in food identify the product's sanitary and conservation state; thus, they are indicative of consumers' health risks. Tsirinirindravo et al noted that high levels of *E. coli* exceeding thestandard limits define the product as inappropriate for commercialization and consequently for human consumption due to the faecal contamination [25, 26].

Microorganisms	**1**	**2**	**3**	**4**	**5**
	Av CFU/ml	Av CFU/ml	Av CFU/ml	Av CFU/ml	Av CFU/ml
FMT Mesophylls	18,11	10,33	17,42	12,94	16,48
CT	11,21	5,84	6,89	7,01	11,42
S.aureus	2,36	3,42	2,17	3,95	1,51
Mold	8,03	13,17	12,84	7,97	9 ,31
Psychrotrophs	9,10	6,45	8,20	7,47	6,94
E. coli	5,78	1,94	1,24	1,92	1,11
Listeria m.	Abs	Abs	Abs	Abs	Abs
Salmonella spp	Abs	Abs	Abs	Abs	Abs

FMT : (mesophylls) Flores Mesophiles Totales, CT : Total Coliforms, *E. coli* : *Escherichia coli*, *Listeria m* : *Listeria monocytogenes*, *Salmonella spp* : *Salmonella typhi*, *S. aureus* : *Staphylococcus aureus*. 1 Av : Average 67 Ha. 2 Av : Average Isotry. 3 Av : Average Andravoahangyambony. 4 Av : Average Mahamasina. 5 Av : Average Besarety.

Microbial insecurity was noted for commercialized fresh milk in Antananarivo, capital city of Madagascar. The high levels of deteriorating and pathogenic microorganisms revealed poor hygienic and sanitary quality in the products analysed and the need for goodpractices in food manipulation and commercialization, coupled with efficient monitoring and surveillance by authorities.

References

[1] Astyn, M.L.deBuyser, F.Guillieretal. "First evidence of a food poisoning outbreak due to staphylococcal enterotoxin type E, France, 2009,"Eurosurveillance, vol.15, no.13.

[2] Chukuezi, "Food safety and hygienicpractices of street food vendors in Owerri,Nigeria," in Studies in Sociology of Science,vol.1, pp.50–57, 2010.

[3] Cappuccino Gj, Sherman N. 1999.Microbiology, A laboratory manual:Biochemical activities of microorganism, fifthed. Benjamin/Cumming science Publishing,California. pp 93-116.

[4] Cappuccino Gj, Sherman N. 1999.Microbiology, A laboratory manual:Biochemical activities of microorganism, fifthed. Benjamin/Cumming science Publishing,California. pp 93-116.

[5] CDC (Centers for Disease Control andPrevention), Multistate Outbreak of *E. coli*O157:H7 Infections Associated with Milk,2010, https: //www.cdc.gov/ Ecoli/2010/-farmsmilk-11-24-10.html.

[6] Center for Science in the Public Interest(CSPI) 2013. Antibiotic Resistance inFoodborne Outbreaks, Washington DCCheesbrough M 2000.

[7] Chung M, Kim C and Ha S. 2010. Detectionand enumeration of microorganisms in readyto-eat foods, ready-to-cook foods and fresh-cutproduce in Korea. J Food Safety, 30(2), 480-489.

[8] Clarence SY, Obinna CN and Shalom NC2009. Assessment of bacteriological quality ofready to eat food (Meat pie) in Benin City metropolis, Nigeria. Afri. J. Microbiol. Res, 3(6): 390-395.

[9] Clinical and Laboratory Standards Institute (CLSI).Performance standards for antimicrobial susceptibility testing.17th information supplement.M100-S17.Wayne, Pa: CLSI; 2007. [11] D.M.Tigre and M.A.N.Borelly, "Research on positive *Staphylococcus* coagulase in fresh milk samples sold by street vendors on the beaches of Itapua (Salvador-BA)," in Review of Medical and Biological Sciences, vol.10, pp.162–166, 2011.

[10] Delamare, Andrade, Mandelli, Almeida, Echeverrigaray, "Microbiological, physicochemical and sensorial characteristics of serrano, an Artisanal Brazilian Milk,"Journal of Food and Nutrition Sciences, vol.03, no.08, pp.1068–1075, 2012.

[11] District laboratory practice in Tropical Countries, part 2, Cambridge University Press. www.cambridge.org.

[12] E. Heikens, A. Fleer, A. Paauw, A. Florijn, and A. C. Fluit, "Comparison of genotypic and phenotypic methods for species level identification of clinical isolates of coagulase negative 6 International Journal of Microbiology. *Staphylococci*," Journal of Clinical Microbiology, vol. 43, no. 5, pp.2286– 2290, 2005.

[13] International Commission on Microbiological Specifications for Foods."Mayonnaise and salads dressings, In: Microorganisms in Foods 6 – Microbial Ecology of Foods Commodities. London:Blackie Academic and Professional; pp. 411-414, 1998.

[14] P. Fegloand K. Sakyi, "Bacterial contamination of street vending food in Kumasi, Ghana," Journal of Medical and Biomedical Sciences, vol.1, no.1, pp.1–8, 2012.

[15] Portese, M. B. Veiros, C. Feldman, and S. B. Cavalli, "Food safety and hygiene practices of vendors during the chain of street food production in Florianopolis, Brazil: A cross sectional study,"Food Control, vol.62, pp.178 186, 2016.

[16] Subratty A.B., Beeharry P., and Chan-Sun M., "A Survey of Hygiene Practices amongFood Vendors in Rural Areas in Mauritius", Nutrition and Food Science, Vol. 34 Issue: 5, pp.203-205, 2004.

[19] Tsirinirindravo H.L., Randrianierenana L A, Andrianarisoa B, Raherimandimby M ,Randrianantoandro HH , Razafinjatovo DN ,Guilhem De Percin 3, PierluigiBozzi. Aspects épidémio-cliniques des toxi-infectionsalimentaires collectives (TIAC) dans la régionAnalamanga, cas de janvier à juin 2015. Communication lors des Journées QualiReg 2016. 5eme rencontre de l'Agroalimentaire en Océan Indien Saint Pierre, La Réunion.

[20] Tsirinirindravo H.L., Randrianierenana LA, Andrianarisoa B, Raherimandimby M, Randrianantoandro HH, Razafinjatovo DN, Guilhem De Percin 3, Pierluigi Bozzi. Espèces de *Salmonella* multiresistantesvéhiculées par les aliments de rue à Antananarivo. Communication lors des Journées QualiReg2016. 5eme rencontre de l'Agroalimentaire en Océan Indien. Saint Pierre, La Réunion.

[21] Walsh C., Fanning S., " Antimicrobialresistance in foodborne pathogens:a cause forconcern" Curr. Dru. Targ. 9,808-815,2008.

[22] World Health Organization (WHO).(2010). Basic steps to improve safety of streetvended food. International Food SafetyAuthorities Network (INFOSAN), INFOSANInformation Note No.3/2010 Safety of streetvended food.

The Processing Technology of "Pundang Seluang" , Fisheries Typical Product From Banyuasin, South Sumatera

Helmi Haris[1], Arif Irawan[2], Riya Liuhartana[3]

[1]Lecturer in The Department of Food Technology Master, Djuanda University
Jl. Ciawi Raya No. 1 Bogor, Tellphone 082110319825
[2]Students Master of Food Technology Study Programe at Postgraduate SchoolDjuanda University
[3]Lecturer in the Department of Fisheries, PGRI Palembang University

ABSTRACT

South Sumatra is famous for traditional fisheries-based food, one of which is Pundang. Although overall South Sumatra fishery products are more varied, both in type and form, but to compete at the national level, our products are still far behind in packaging techniques. Especially for Pundang products, until now there has not been a standardized standard regarding the quality and processing process, so the legislation produced by one processor with the other processors varies greatly. Because of the lack of quality standards and technological processing of standard, then this article aims to introduce Pundang as one of the flagship products of processed products fishery products typical of South Sumatra, with the hope of someday Pundang can really become a traditional product excellent fishery typical South Sumatra. This paper provides an overview of some of the research that has been conducted at the Faculty of Fishery University of PGRI Palembang, which contains: definition and terminalogi about Pundang, raw materials (Seluang fresh) and the equipment used, the technology processing, drying and packaging design Pundang who have fulfilled requirements both in terms of hygiene, quality and appearance, and with a longer shelf life.

Keywords: Nutrient content, Packaging design, Process technology. Pundang Seluang, and Standards Quality.

I. INTRODUCTION

South Sumatra is one of the provinces that has a fairly wide public waters, namely in the form of rivers, swamps, lakes, damp, and other lowlands that are flooded with water. So that the potential of biological resources of public waters is quite large. The fisheries sector is one of the biggest contributors to animal protein consumed by the people of South Sumatra.

Based on data from the Department of Marine and Fisheries of South Sumatra Province in 2014 in the Field of Cultivation, the area of public waters reached 2.5 million hectares. From these public waters there are various types of economically important fish, among them are Seluang fish (*Rasboraspp* .). In South Sumatra, the supply of Seluang fish generally comes from catches in the main river and on the Musi tributaries and swamps that are widely distributed in South Sumatra.

At present,Seluang has become an elite class of food, which is served in restaurants.Seluang can be processed to dry, so it is crispy when fried. This dry cell in the MusiBanyuasin area is better known as "Pundang" . becouse it's feels is fresh, it can be processed into various interest products (1).

The quality of the legislation produced by the community is still diverse, because there is no standard treatment process. Between one processor and another processor, the quality is still diverse. Another disadvantage is that the packaging technique used is still weak and the shelf life is

short, so not many people outside the area know the advantages and disadvantages of this law. In the future, there is a need for a standard processing technology, which has fulfilled the requirements both in terms of hygiene, quality and appearance, and with a longer shelf life.

Therefore this issue is important to think about so that there are standard standards in this statutory processing technique. A good packaging technique needs to be developed, so that the lawn can be packaged to be more hygienic, with a more attractive appearance and a longer shelf life. So that people can enjoy the law at any time, even if it's not in the middle of the season.

The discussion in this paper aims to: 1) Undestand what Pundang products are, 2) Undestand the raw material wich used in the Pundang Seluang Processing, 3) Explain of The Pundang Sekuang Processsing, 4) Pepformanced packaging design legislation so as to provide a more attractive appearance, hygienic, and practical

Benefits from this paper is:In order this product more familiar with what it Pundang, l understand are raw materials, Pundang step in the process, get to know pundang packaging design which can provide a more attractive appearance, hygienic, and practical, as well as promoting Pundang be one alternative culinary products souvenirs typical of South Sumatra .

II. RESEARCH METHODOLOGY

This research is a series of research activities on Pundang Seluang conducted in Sekayu City, MusiBanyuasiDistrict , South Sumatra, and has been going on from 2013 until now, it continues.

This study uses a field survey method and a series of experiments on the processing of the Pundang Seluang. There is an initial stage of the survey methods, starting from studying the technology of processing in the traditional processing level. After that the experimental method is carried out through modification at the stage of the treatment process , which includes improving the method of processing, drying, and packaging. So that we get the recommendation of Modified Processing Technology of Pundang Seluang (2).

III. RESULTS AND DISCUSSION

Defenition of Pundang Seluang

Based on the results of field survey conducted in the area Sekayu and its surroundings, it was found that the definition of the Pundang Seluang is drying small fish (includingSeluang fish) with **a slight** addition of salt and sugar. While giving the salt with **a higher** concentration are called "Balur" (Salted Fish) (1 and 3).

The term Pundang is only used for the Musi Banyuasin and Banyuasin District only, for other regions in South Sumatra this term is not known. According (4 and 5), in the area of Central Kalimantan, the term Pundang is also known as with a different understanding, because it is not only intended for drying fish. In this area is the understanding Pundang is saltingfish or meat that is dried in the sun to dry it evenly.

The form of the Pundang Seluang image produced by the community in the MusiBanyuasin area can be seen in Figure 1.

Figure 1. Pundang Seluang
Source photos: (6)

The Technology Process of Pundang Seluangat Processing Performers Level

Processing of legislation at the (traditional), sanitation and hygiene level of processing is still not getting enough attention. The equipment used and the method of processing is not yet adequate. Giving salt in small amounts only, most **Performers** invite anyone to add sugar to add flavor of Pundang..

Drying is done by spreading fish on top waring on the ground, the court of bamboo or wood. Because the conditions are in the open air, it is very likely that it will be contaminated with garbage, animals, gravel, and of course it will be a location that is easily contaminated by flies. Therefore the drying results are not clean and hygienic. Product packaging has not been done specifically, only in the form of plastic bag packaging or plastic mica boxes in staples without labeling.

The dry cell display (Law) produced in traditional processing methods is not uniform, both in terms of shape, size, color, and the level of dryness of the product. This is due to the fact that the handling process of the processing has not been standardized , so that the resulting quality is very diverse (7).

In practice in the field, there is some variation between the lawyer if the one with the other Pundang processing, for example in fish weeding there is no split, there were cleaved partly butterfly shape. if there are adding about 3% salt and sugar to taste, partly did not do it. On drying there were dryed for 2-3 days, some of which there are up to 3-4 days. Selection of packaging varies between a lawyer if the other Pundang processing. Becouse, the quality of the lawyer if Pundang traditional laws vary widely and there is no standardized quality standards.

A variety of treatments exist in the community, so the authors group them into 2 processing groups, namely: Method of Processing I (P1) and Method of Processing II. (P2),

Method of Processing I : Processing is carried out by the Fishermen's Family, the raw material comes from the catch of the fishermen directly from the river around the residential village.Furthermore , elephant with various sizes and types of weeded, washed and soaked in salt solution with a salt size of about 5-10 percent by weight of fish. Some also add enough sugar for flavor enhancers .The next step is drying by sunlight (approximately 2-3 days) on normal weather and the resulting P legislation ready for sale without any special packaging. The results of the processing of the processing method I, the color is rather dark, the size is not uniform, the water content is still quite high with the aroma of salted fish.

Processing Method II: Treatment by Entrepreneur Pundang, d ith raw material obtained by purchasing from fishermen mem surroundings. The next stage S eluang washed clean and do the sorting and grading by size more uniform. Seluang that have a uniform size of discarded entrails and split with a butterfly shape and then soaked in salt solution with a mild concentration (about 3%) . The nodules aredried in the sun . Drying takes between 3-4 days to produce a colorless transparent legislation P whitish, with a uniform size and droughts drier, and without any aroma of salted fish.In summary, the differences between the two ways of processing can be seen in Table 1 .

Table 1 Differences in Law processing processes at the business actor level

No.	Details	Processing Method I	Processing Method II
1	Sources of raw materials	Own catch	Buy results from surrounding fishermen
2	Equipment and processing methods	Simple	It's more advanced
3	Washing water source	Directly from river water	River water has been collected in a reservoir
4	Who process	The fisherman's family itself	Processors / Entrepreneurs
5	Marketing	Directly at the production site	In production sites, sales outlets or restaurants
6	Packaging	Crackle bags	K mica brain ber label

7	Invite View	Less dry, rather dark colors, the smell of salted fish, shapes and sizes vary	A bit dry, butterfly shape, bright colors, without the smell of salted fish, the shape and size are more uniform

Source: (8).

Method of Processing I (P1) and Method of Processing II. (P2), as shown in the flow chart of the processing process in Figure 2 .

Processing Method I

Fresh Seluang Fish
(Own catch)
⇩
Weeding
(alongside the river on a board)
⇩
Giving form
(irregular)
⇩
Washing
(Directly with river water)
⇩
tub)Giving salt + sugar to taste
(5- 10% by weight of material)
⇩
Drying in the sun
(2-3 days)
⇩
Dried Pundang Seluang

Processing Method II

Fresh Seluang Fish
(Buy from other fishermen)
⇩
Weeding
(ina spacial place)
⇩
Giving Form
(butterfly shape)
⇩
Washing
(River water that has been collected with a
⇩
En soak in salt solution
(Concentration) 3 % ,1 hours)
⇩
Washing
⇩
Drying in the oven
(Temperature 45 ^{O} C, 8-10 hours)
⇩
Sorting and Grading
(Grouping size)
⇩
Dried Pundang Seluang

Picture 2 . Flow chart of Pundang Seluang Processing (The first and Second Processing)
Source: (6).

In fact, in the field, how to handle raw materials, salting methods, and drying are still done in a minimum. This causes many dry fish that are not homogeneous, the quality is not good, and various deficiencies still need to be addressed (9).

3. Pundang Seluang **Quality standard**

Because of the limited information and literature on Pundang Seluang, then up to understandThe Quality Standard ofPundang Seluangfor the time being, the ulcer still refers to the Quality Standards of Dry Salted Fish . namely as follows:

Table 2. Quality Requirements for Dry Fish

Test type	Unit	Quality Requirements
a. Organoleptic - Value, min	 Numbers (1-9)	 7
b. Microbiology - Total Plate Numbers - E. coli - Salmonella * - Vibrio cholera * - Staphylococcus aureus *	 colony / gr APM / gr per 25 gr per 25 gr colony / gr	 Maximum 1 x 10^5 Maximum 3 Negative Negative Maximum 1 x 103
c. Chemistry* - Water content,% Weight / weight, max - Salt,% weight / weight, max - Ash does not dissolve in acid,% weight / weight, max	 % of mass transactions % of mass transactions % of mass transactions	 40 20 0.3

*) Recommendations if needed
Source: (10).

Based on the results of the legislative analysis conducted at the TPHP Workshop of the Faculty of Fisheries, University of Palembang PGRI and at the Bogor Agro Industry Center (BBIA), the quality of the Law produced from the first and second processing methods can be seen in Table 3. Table 3 . The average results of the quality analysis at the level of business actor

Quality	Details	Way Processing I	Way Processing II
Chemistry	- Water content,% - Protein,% - Carbohydrates,% - Fat,% - Ash does not dissolve in acid,% - Salt,%	23.16 62.43 3.46 2.41 0.50 4.19	19.81 69.13 3.95 2.35 0.47 0, 5 9
Microbiology	- ALT, colony / gr - E. coli APM / gr	2 , 5 x 10^4 1.17	2 , 1 x 10 3 1
Organoleptic	- Invite Views (Appearance, Smell, Text stur and Pert. mold)	6.6	7.1

Sources: (6).

Judging from the average observations analyzed by the T test level of 5% and 1%, then between the two methods of processing, for the parameters of Water, Protein, Salt, Total Plate Number (ALT) and Sensory Test there are differences in the effect of the two treatment methods , while for the parameters of carbohydrates, fats, acid insoluble *ash* and *Escherchia coli* , there was no difference in the effect of the two treatments.

Judging from the chemical quality, the moisture content of Treatment Method II (19.81%) was lower than the Processing Method I (23.16%). This is because in the Processing Method II the drying time ranges from 24-32 hours or 3-4 days of drying, while the Method of Processing I drying only lasts 16-24 hours or 2-3 days drying. Thus the water content in the Processing Method II is lower than the

first method. This is in accordance with the opinion of (9), that adequate drying can reduce the water content of the material, so that the material lasts longer and has a longer shelf life.

Protein levels in Treatment Method II (69.13%) are higher than Processing Method I (62.43). This is thought to be related to differences in water content. P enurunan Moisture material will change the nature of the fish meat fresh form, but will increase the nutritional content (9). While the Salt Levels in the Processing Method II are lower, because indeed in the Processing Method II salt addition is only modest (a maximum of 3% of the weight of the material), so it tastes rather tasteless and this is preferred by consumers, because more choices for processing into various processed products others (11, 12, and 10).

Judging from the quality of Microbiology, there were differences in the effect of the two methods on the parameters of the Total Plate Number (ALT) but for the *Escherchia coli* parameter , there was no difference in the effect of the two treatments. This is because in the Processing Method I, the handling is less hygienic. This contamination can occur because the raw material itself has been contaminated or polluted during the handling process. Besides that, the high water content of Pundang will also affect the water activity (Aw) of the material is also high, thus the ability of microorganisms to develop in food will also be faster (13 and 14).

Although it is still within the permissible limits, what needs to be considered in the processing process at the Business Actors level is the sanitation and hygiene process, because the discovery of *E. coli* in the final results. This can occur because of contamination from the initial raw material or contamination during the processing. As stated by (13), that the presence of *E. coli* in food is an indication of poor sanitation processes. Therefore washing factors, sanitation in weeding and drying need to be a concern.

The Organoleptic Test Results (Sensory Test) in the Law resulting from the second processing method are higher than the first processing method (Picture 2.) This shows that panelists prefer the appearance of the Law (appearance, smell, texture, and growth of molds) as a result of processing the second method. In the second processing method, it produces a drier Pundang, a butterfly shape, bright colors, without the smell of salted fish, and a more uniform size.

4. Improvement of Processing Technology

Basedonthe analysis of weaknesses Pundang Seluang processing traditionally,we conducted a series of studies to improve Pundang Treatment Process Technology for the rehabilitation of processing, drying / drying, packaging and shelf life determination Pundang Seluang. Based on the results of the previous research, recommendations were made for the flow chart of the processing process as follows Figure 5.:

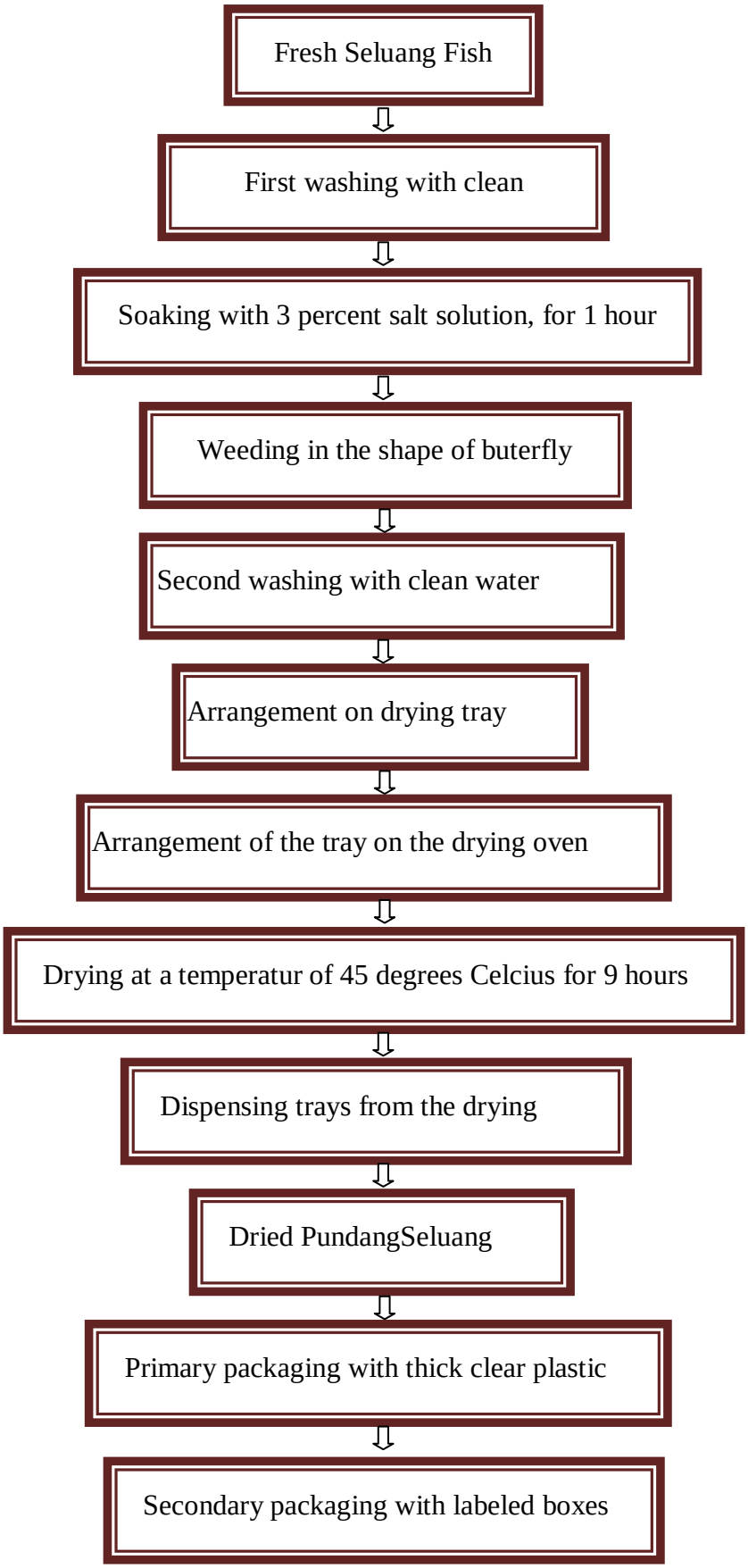


Figure 4 . Recommended Flow Chart of the Pundang Seluang Processing Process

The Pundang Seluang Processing

1. Raw Materials (FreshSeluang Fish)

The raw material used is selected from Seluang fish which is still fresh from the catch. Because if it's not really fresh, because the size of the Seluang fish is small, then we will have difficulty in weeding.

2. Washing I with clean water

This Washing I aims to remove impurities from the raw material that will be used for making the Law.

3. Weeding with a knife

Weeding aims to remove all dirt and stomach contents from Seluang fish, so as not to become contaminated for the next process.

4 . Giving the shape of a Butterfly

Giving a butterfly shape is by dividing the abdomen to the chest with a sharp knife, so that when developed it will form like a butterfly (Butterfly).

5. Washing II with clean water

Washing stage II aims to clean fish from dirt and blood again which is still attached to a fish that has formed a butterfly.

6 . Soaking in a 3% salt solution, for 1 hour .

Soaking Seluang fish that has been weeded in 3 percent salt solution for 1 hour is so that the salt solution is absorbed evenly into the fish meat, which can add flavor to the Law that will be produced.The salt used as part of it is iodized salt, so besides adding flavor, it is also useful as a source of iodine minerals for consumers who consume it.

7. Arrangement on a drying tray

After being removed from the salt water bath, Seluang fish is arranged on a drying tray by developing the hemisphere of the butterfly, with the lower part of the stomach contents, so that when the dried Pundang is produced it really expands like a butterfly.

8. Preparation of trays in a drying oven

Seluang fish, which has been arranged on a tray, is put into a drying oven with a multilevel system.

9. Setting temperature and drying time (45 ^{0} C, 9 hours)

Then the drying temperature is set to 45 ^{0} C and the timer is set for 9 hours, and the oven door is closed. During drying, fish are turned back and forth every 3 hours, so that drying can be evenly distributed.

1 0. Remove the drying tray from the drying oven

After the Dry Law (about 9 hours temperature 45 ^{0} C), the Law can be lifted to air dry, so that when packaged it does not produce water money.

11. Primary packaging with vacuum plastic

Primary packaging is done by packing the law into clear thick polyethylene plastic packaging, so that it can inhibit the entry and exit of water vapor into the packaging, so that the packed packaging is not quickly damaged.

12. Secondary packaging with labeled carton box

Furthermore, the legislation that has been packaged with primary packaging, to improve its appearance, is packaged with secondary packaging in the form of a labeled carton box, which contains information about the product name, manufacturer's address, net weight, nutrient content,

method of manufacturing process and other information needed by consumers, such as expiration, halal labels, etc.

Fresh Seluang Fish

Washing I with clean water

Weeding with a knife

Giving the shape of a Butterfly

Washing II with clean water

Soaking in a 3% salt solution, for 1 hour

Arrangement on a drying tray

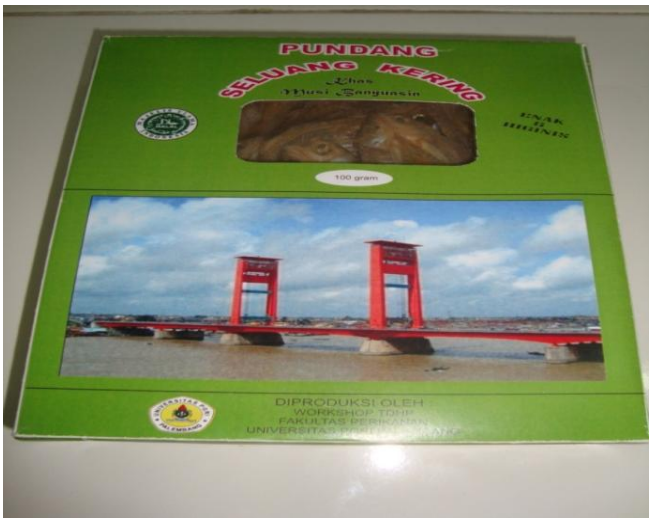
Preparation of trays in a drying oven

Temperature and drying time (45 ^{0} C, 9 hours)

Remove the drying tray from the drying oven

Dried Pundang Seluang

Primary packaging with thick clear plastic



Secondary packaging with labeled carton box

Figure 5 . Flow chart of Pundang Seluangprocessing
Source: (7)

Figure 6 . Various forms of packaging legislation that are ready to be marketed
Source: (7)

Varian of the package that has been developed at the University of Fishery Products Processing Workshop PGRI Palembang is not only a combination of primary packaging PP transparent plastic withcardboard boxes labeled secondary packaging, but there is also a plastic primary packaging labeled Plastic thick, with a variety of hangers and standing pounch (as shown in Figure 6) above. Variations of various packaging for Pundang Seluang are favored by consumers because their appearance is more attractive, practical, and more hygienic. So that it can be used as a souvenir (souvenir) typical of South Sumatra (19).

IV. CONCLUSION

Pundang Seluang is one of the processed fisheries products typical of South Sumatra, which is the result of drying of Seluang fish (*Rasborasp . P.*). There are various types of Seluang Fish which are widespread in public waters in South Sumatra, but the types of Seluang that are widely used are the types of SeluangBatang (*Rasboraargyrotaenia*) and SeluangPutih or people in the Sekayu area calling them SeluangLambak (*Rasbora dorsioevellata).*The Process Processing Technology of

Seluang has been introduced which consists of stages: Preparation of raw materials in the form of Fresh Seluang Fish , Washing with clean water, weeding with butterfly shape, Washing II with clean water, Immersion with 3 percent salt solution for 1 hour, Arrangement on a tray dryer, Preparation of drying tray in drying oven, setting drying temperature 45 ^{0} C for 9 hours, Expending drying tray from oven which produces dry Pundang Seluang, Primary packaging with clear PP plastic, Secondary packaging with total labeled. Workshop on Fishery Product Processing University of Palembang PGRI has also developed a variation of Pundang Seluang packaging in the form of a thick P P plastic primer labeled, with a variety of hangers and standing pounch . Pundang Seluang has now begun to become a trade mark to be used as souvenirs or gifts for guests visiting South Sumatra or sent as souvenirs to relatives, business partners, and handicrafts as a distinctive feature of processed products from South Sumatra.

V. ACKNOWLEDGEMENTS

This article is part of a research activity " Improvement of Processing Technology to Improve Dried Pundang Seluang Quality as aexcellent fishery product from South Sumatra " funded by theDirectorate of Higher Education DRPM Research Grant Competitive Scheme in 2013- 2014 and continued in 2017-2018 to lead researcher Dr. Ir HelmiHaris, MS. This article was presented at the Seminar on Research result that have been completed in 2018. Palembang-Indonesia on 2nd May 2018.

REFERENCES

[1.] Department of Marine Affairs and Fisheries of South Sumatra Province in the Field of Cultivation. 2015. Annual Book of Aquaculture Statistics 2014. Department of Marine Affairs and Fisheries of South Sumatra Province. Palembang

[2.] Anonimous. 2015. 2014 Yearbook of Aquaculture Statistics. Department of Marine Affairs and Fisheries of South Sumatra Province. Palembang

[3.] Infokito. 2007. Patented Muba Industrial Products. (On line) (http://infokito.wordpress.com). Retrieved February 2, 2020.

[4.] Angking. 2009. Salted Fish Pundang. (On line) (http://angking.wordpress.com). Retrieved February 2, 2020.

[5.] Rawit, N. 2009. Maneser Pan or Tatu Hiang. (On line) (http://maneser.kalteng.net). Retrieved February 2, 2020.

[6.] Liuhartana, R. and H. Haris. 2011. Identification of Dry Seluang (Pundang) Processing Process and Its Nutrient Analysis in Traditional Processing. Journal of Fisheries and Aquaculture. ISSN.1693-6442 Vol. 6, No.1, December 2011, Page: 41-54.

[7.] Haris, H., Liuhartana, R., Jaya, F.M., and E. Robiyardi. 2014. Process Technology Improvements to Improve Pundang Quality. End of Year Report Second Competitive Grants 2014. DP2M Dikti. Jakarta.

[8.] Haris, H. and R. Liuhartana. 2012. Packaging Design To Improve The Function And Appearance Of The Dry Package (Pundang). Journal of Fisheries and Aquaculture. ISSN.1693-6442, Vol. 6, No.1, December 2011, Page: 27-40.

[9.] National Standardization Body. 2006. Indonesian National Standard (SIN) Dried Salted Fish, SNI 2721.1: 2009. National Standardization Body. Jakarta.

[10.] National Standardization Body. 2006. Indonesian National Standard (SNI) for Dried Salted Fish, SNI 2721.1:2009. National Standardization Body. Jakarta.

[11.] Riadi, S., and F. Muliajaya. 2009. Diversification of Seluang Fish Processed in Palembang City. PGRI University of Palembang. Palembang.

[12.] Husnah and M.N. Arsyad. 2009. Species Diversity, Distribution, Habitat and Biological Characteristics of Seluang Fish (Rasbora sp.) In Public Waters. PGRI Palembang University Collaborates with the Public Aquatic Fisheries Research Center. Palembang.

[13.] Haris, H, dan R. Syarief. 2016. Pengantar Teknologi Pengemasan. Fakultas Perikanan Universitas PGRI Palembang. Palembang.

[14.] Bintang, Y.M., Pongoh, J. and H. Onibala. 2013. Construction and Capacity of Solar Fish Dryer System for Unloading. https://ejournal.unsrat.ac.id/index.php/jmthp/article/view/1632. Accessed April 20,2020.

[15.] Haris, H. 2013. Pundang Seluang "Superior Products of Fishery Products Typical of South Sumatra. Proceedings of Research Results and Abdimas UNINDRA 2013 ISSN No. 2355-5238. Vol. 1, Year 2013, Page: 335-347.

[16.] Haris, H. dan M. Fadli. 2014. Penentuan Umur Simpan (Shelf Life) Pundang Seluang (Rasbora sp.) Yang Dikemas Menggunakan Kemasan Vakum dan Tanpa Vakum. Jurnal Saintek Perikanan, Indonesia Journal of Fisheries Science and Technology, UNDIP Semarang, ISSN 1858, Vol.9/No.2/Februari2014. Hal : 53-62.

[17.] Haris, H. and A. Agustiawan. 2017. Drying Temperature Variations Against Quality Pundang Seluang. Journal of Fisheries and Aquaculture. ISSN.1693-6442, Vol. 6, No.1, December 2011, Page: 27-40.

[18.] Haris, H., Widayatsih, T, and Asmawati. 2019. Integrated Fisheries Business at the Faculty of Fisheries, Universitas PGRI Palembang. NGAYAH Journal, Bali Region Science and Technology Service Forum (FlipMas), July 2019 Vol. 10 No. 1 page: 8-21. ISSN: 2087-118X (Print) ISSN: 2580-7757 (Online).

[19.] Haris, H. 2018. "Pundang Seluang" Superior Products Typical Fishery Products of South Sumatra. Plantaxia Publishers. Yogyakarta. 102 p.

International Journal of Innovation Engineering and Science Research
(ISSN: 2581-4591)
www.ijiesr.com

Vitamin D and Consequences for Phospho calcium Metabolism in Dnid

VITAMINE D ET CONSEQUENCES SUR LE METABOLISME PHOSPHOCALCIQUE CHEZ LES DNID

Pr A-S. SAADI-OUSLIM[1,4], Dr F-Z MEGDAD[1,4], Dr M. ZENDJABIL[2,4], Dr C.ZAOUI [3,4], I.A OUSLIM [3,4] , Pr T.SAHRAOUI[3,4]

1 : Biochemistry department EHU-ORAN,
2: Biochemistry department CHU-ORAN,
3 : Biology department Belgaid,
4 : AHMED BEN BELLA 1 University

Summary

Introduction: Vitamin D deficiency appears to have significant metabolic, vascular, immunological and bone consequences in diabetics. We evaluated its prevalence and its consequences on phosphocalcic metabolism in a sample of diabetics.

Materials and Methods: Study carried out between October 2020 and January 2021 on 123 patients (94 women and 29 men) sex-ratio of F/H= 3.24, all type II diabetics with a mean age of 52 years. Vitamin D (25 OH-D3) was measured on a VidasBiomérieux automated system and the determination of calcemia, phosphoremia and albumin (corrected calcemia) were carried out on an ADVIA 1800 SIEMENS automated system with 2 levels of control.

Results: Of the 123 patients who participated in the study, 93% were vitamin D deficient (< 30 nb/ml) and 40% were severely deficient (< 10 nb/ml). Similarly, the calcium/TIV D ratio was low in only 33% of patients P = 0.04, and the phosphorus/TIV D ratio was low in only 36% of patients P = 0.06. The calcium/phosphate ratio was not significant. In logistic regression, low vitamin D (< 20 nb/ml) was only associated with the duration of diabetes, with no relation to age or sex, and the impact on the phosphocalcic balance was more metabolic than cardioactive.Our work is in line with the literature and our study is consistent with the new study published in the European Journal of Endocrinology published in 2017.

Conclusion: Vitamin D is an essential element in the fight against disease. It acts on the bones and prevents osteoporosis, activates the immune system and prevents all types of infection. Its deficiency is frequent in NIDDM without disturbing the phosphocalcic balance according to our results and according to certain randomized studies on large cohorts. Nevertheless, the monitoring of the phosphocalcic balance and the vitamin capital in the DNID must be well codified and carried out regularly in order to avoid certain complications.

Key words: vitamin D, type 2 diabetes, phosphocalcic balance, insulin resistance, hypovitaminosis

Résumé :

Introduction : La carence en vitamine D semble avoir des conséquences significatives chez diabétiques aussi bien sur le plan métabolique, vasculaire, immunologique et osseux. Nous avons évalué sa prévalence et ses conséquences sur le métabolisme phosphocalcique sur un echantionnage de diabétiques.

Matériels et Méthodes : Etude réalisée entre octobre 2020 et janvier 2021 sur 123 patients (94 femmes et 29 hommes) sex-ratio de F/H= 3.24, tous diabétiques de type II avec un âge moyen de 52 ans. La vitamine D (25 OH-D3) a été dosée sur automate Vidas Biomérieux et le dosage de calcémie, phosphorémie et d'albumine (calcémie corrigée) ont été réalisé sur automate ADVIA 1800 SIEMENS avec 2 niveaux de control.

Résultats : Sur les 123 patients ayant participé à l'étude 93 % avaient une carence en vitamine D (< 30 nb/ml) sévère chez 40 % (< 10 nb/ml). De même, le ratio calcium / VIT D n'était bas que chez 33 % des patients P = 0,04, et le ratio phosphore / VIT D n'était bas que chez 36 % des patients P = 0,06. Le ratio calcium / phosphate e tait non significatif. En régression logistique, la vitamine D basse (< 20 nb/ml) n'était associée qu'à la durée du diabète, sans rapport avec l'âge ou le sexe, et les répercussions sur le bilan phosphocalcique étaient plus d'ordre métabolique que carentiel.Notre travail rejoint la littérature et notre étude va dans le sens de la nouvelle étude publiée dans l' *European Journal of Endocrinology* publiée en 2017.

Conclusion : La vitamine D est un élément essentiel pour lutter contre les maladies. Elle agit sur les os et prévient l'ostéoporose, active le système immunitaire et permet d'éviter toute type d'infection. Sa carence est fréquente lors du DNID sans pour autant perturbé le bilan phosphocalcique d'après nos résultats et selon certaines études randomisées sur de grandes cohortes néanmoins la surveillance du bilan phosphocalcique et le capital vitaminique chez le DNID doit être bien codifiée et réalisée de façon régulière afin d'éviter certaines complications.

Mots clefs:vitamine D, diabète type 2, bilanphosphocalcique, insulinoresistance, hypovitaminose.

I. Introduction

Vitamin D deficiency appears to have significant metabolic, vascular, immunological and bone consequences in diabetics. We evaluated its prevalence and its consequences on phosphocalcic metabolism in a sample of diabetics. The importance of vitamin D in bone metabolism is long established but recent publications have reported the potential extraosseous effects of vitamin D. The area of bone and muscle fragility has been explored in randomised trials.

Vitamin D is increasingly seen as one of the main environmental factors that can limit the risk of occurrence and progression of certain chronic diseases, particularly cardiovascular and metabolic diseases. For example, a link has been suggested between vitamin D and type 2 diabetes

In many international studies it has been shown that vitamin D deficiency is associated with a high risk of developing insulin resistance and type 2 diabetes. Indeed, this vitamin could interact with the various physiopathological mechanisms governing insulin secretion, insulin resistance and the parameters of carbohydrate homeostasis. It could also be involved in the complications of type 2 diabetes.

II. Materials and Methods

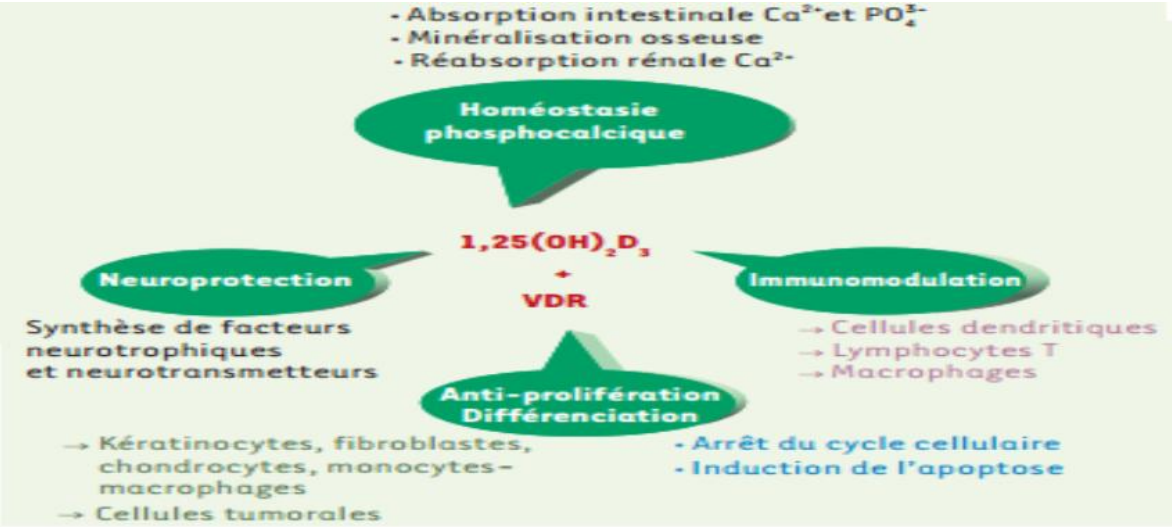
Study conducted between October 2020 and January 2021 on 123 patients (94 women and 29 men) sex-ratio of F/H= 3.24, all type II diabetics with a mean age of 52 years (28-76 Years). Vitamin D (25 OH-D3) was measured on a VidasBiomérieux automated system and the measurement of blood

calcium, phosphorus and albumin (corrected blood calcium) was carried out on an ADVIA 1800 SIEMENS automated system with 2 levels of control.

III. Results and Discussion

Vitamin D of cutaneous origin is transported in the blood, by a carrier protein (vitamin D-binding protein , DBP) and dietary vitamin D is transported by DBP and lipoproteins, to the liver where it is hydroxylated to 25OHD (calcidiol, a biologically inactive form), and then to the kidney for a 2nd hydroxylation, by 1α hydroxylase to 1,25(OH)2 D. The resulting 1,25dihydroxyvitamin D (or calcitriol) is the biologically active form of vitamin D responsible for bone and extra-bone effects

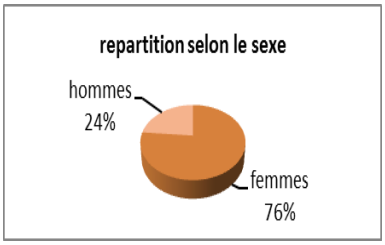
1,25(OH)2 D has a major role in the regulation of phosphocalcic metabolism and calcium homeostasis, acting on the parathyroid, kidney and intestine. 1,25(OH)2 D maintains physiological calcium levels by increasing intestinal calcium absorption, and by acting directly on bone, via an action on the vitamin D receptor (VDR) located in osteoblasts. The vitamin D-bound VDR activates the RANK/RANKL system, which increases osteoclastogenesis and thus promotes the release of calcium and phosphorus.



Physiological and biochemical role of vitamin D

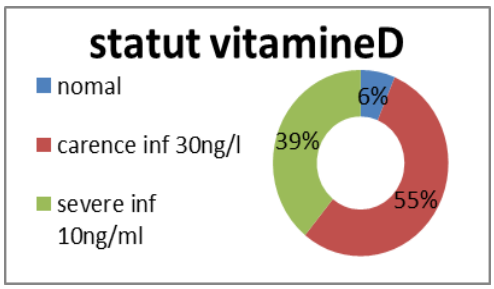
Our study shows that 64% of the patients were over 50 years of age and only 36% were under 50 years of age and that 65% of the patients had diabetes for more than 5 years and 35% for less than 5 years.

Our work shows that the prevalence of vitamin D deficiency and deficiency in type 2 diabetic patients is high and alarming, and that it predominates in women (76.42%), whereas it represents only 23.58% in men.



Of the 123 patients who participated in the study 93% were vitamin D deficient (< 30 ng/ml) and 40% were severely deficient (< 10 ng/ml). Similarly, the calcium/TIV D ratio was low in only 33% of patients P = 0.04, and the phosphorus/TIV D ratio was low in only 36% of patients P = 0.06. The calcium/phosphate ratio was not significant. In logistic regression, low vitamin D (< 20 ng/ml) was only associated with the duration of diabetes, not with age, and the impact on calcium and phosphorus status was more metabolic than deficiency-related. There is an important link between vit D and insulin secretion, especially in people with a non-functional VDR. There is an alteration in glucose tolerance and a decrease in the

maximum capacity for insulin secretion independently of changes in blood calcium levels. Our work is in line with the literature and our study is in line with the new study published in the European Journal of Endocrinology in 2017 and Quebec researchers have shown that this vitamin D could slow the progression of the disease in patients diagnosed with pre-diabetes or early type 2 diabetes.



The levels of vitamin D in our population are in agreement with other results found in other studies. In line with our study an American team from Washington University in St Louis, Missouri has just published a study on the possible role of vitamin D in diabetic patients. Some data had already shown that diabetics have a 20% deficiency in vitamin D levels, and that this doubles the risk of developing cardiovascular disease. People with diabetes have inflammation of the blood vessels, as diabetes turns some white blood cells into macrophages that stick to the vessel walls. In diabetics with vitamin D deficiency, this process is accelerated and the macrophages bind with cholesterol, resulting in clogged arteries. Researchers have shown that adding vitamin D to isolated macrophages suppresses their adhesion.

In addition, numerous clinical studies with vitamin D supplementation in a population with type 2 diabetes have shown inconsistent effects of the pancreas. These variations in results could be explained by many factors such as

- The ethnic and geographical origin of the populations, the small sample size of the participants in the clinical trials;
- The level of glucose tolerance of the participants and their initial serum vitamin D status;
- -The different methods of measuring vitamin D;
- The duration of the clinical trial with vitamin D supplementation.

In the same setting a cross-sectional study of 488 subjects with PreDM and 25 (OH) D deficiency therefore appeared to be more likely to develop T2DM due to a higher degree of insulin resistance associated with impaired and uncompensated insulin secretory function. The fact that in this study the prevalence of insulin resistance is increased in preDM is not surprising as they have a higher body mass index. The question arises as to the value of 25(OH)D supplementation in deficient and pre-modernised patients, or even obese patients. Epidemiological studies have shown that vitamin D supplementation in childhood reduces the risk of developing type 1 diabetes. A Finnish study showed that the administration of 2000 IU of vitamin D/d to 10,366 children in the first year of life was associated with an 80% reduction in the risk of type 1 diabetes (30 year follow-up) (RR=0.22; 95% CI 0.05-0.89).

Hypovitaminosis D is associated with increased insulin resistance, decreased insulin production, and the development of metabolic syndrome. The mechanism of these associations is still poorly understood. Administration of 1200mg of calcium and 800IU of vitamin D reduces the risk of developing type 2 diabetes by 33% (RR=0.67, 95% CI 0.49-0.90) compared to subjects taking 600mg of calcium and less than 400IU of vitamin D.

IV. Conclusion

Vitamin D is an essential element in the fight against disease. It acts on the bones and prevents osteoporosis, activates the immune system and prevents all types of infection. Its deficiency is frequent in NIDDM without disturbing the phosphocalcic balance according to our results and according to certain randomized studies on large cohorts. Nevertheless, the monitoring of the

phosphocalcic balance and the vitamin capital in NIDDM must be well codified and carried out regularly in order to avoid certain complications.

Vitamin D is considered a good marker of health status. However, vitamin D deficiency or sub-deficiency appears to be increasingly common in the general population. Consistent epidemiological evidence has established a relationship between vitamin D deficiency and the increased prevalence of type 2 diabetes

The resulting analysis concludes that the prevalence of vitamin D deficiency and deficiency in type 2 diabetic patients is alarmingly high and predominantly in women (76.42%),

This work indicates that vitamin D supplementation is a way to reduce the risk of developing cardiovascular disease in people with diabetes

"Vitamin D protects the arteries of diabetics"

Conflicts of interest: the authors declare no conflicts of interest

References

[1.] Diabète de type 2 : et si la vitamine D freinait sa progression ?Julie P.NEWSLETTER SANTEAug 8, 2019

[2.] UPDATE ON VITAMIN D AND EVALUATION OF VITAMIN D STATUS. J.-C. Souberbiell , D. Prié, M. Courbebaisse, G. Friedlander, P. Houillier, G. Maruani, E. Cavalier, C. Cormier . Annales d'Endocrinologie. Volume 69, n° 6. pages 501-510 (décembre 2018)

[3.] VITAMIN D: SKELETAL AND EXTRA SKELETAL EFFECTS; RECOMMENDATIONS FOR GOOD PRACTICE. Karine Briot, Maurice Audran, Bernard Cortet , Patrice Fardellone, Christian Marcelli, Philippe Orcel, Bruno Vellas, Thierry Thomas, Christian Roux. Volume 38, n° 1. pages 43-54 (janvier 2017).

[4.] VITAMIN D AND CALCIUM INTAKE IN RELATION TO TYPE 2 DIABETES IN WOMEN *DIABETES CARE* . Pittas A.G., Dawson-Hughes B., Li T., Van Dam R.M., Willett W.C., Manson J.E., and al. 2016 ; 29 : 650-656

[5.] Déficience en vitamine D: un risque accru de diabète de type 2. Abbasi et al. J Nutr. 2015;145:714–9.

[6.] HYPOVITAMINOSIS D IS ASSOCIATED WITH INSULIN RESISTANCE AND B CELL DYSFUNCTION. Chiu K.C., Chu A., Go V.L.W., Saad M.F. *Am J ClinNutr* 2014 ; 79 : 820-825

[7.] BIOCHIMIE CLINIQUE. PERRE VALDIGUE 2Éme edition1

[8.] *Journal of Biological Chemistry 9 Nov 2012; 287(46):38482-94*

[9.] Vitamine D : effet osseux et extra-osseux ; recommandations de bon usage. Karine Briot, Maurice Audran, Bernard Cortet, Patrice Fardellone, Christian Marcelli, Philippe Orcel, Bruno Vellas, Thierry Thomas, Christian Roux la Presse Médicale ; Volume 38, n° 1 pages 43-54 (janvier 2009)

[10.] Holick M.F. Vitamin D deficiency *N Engl J Med* 2007 ; 357 : 266-281 [cross-ref]

AFFILIATION

Pr SAADI - OUSLIM AMAL SOULEF

- LECTURER "A" IN BIOCHEMISTRY
- Head of Biochemistry Department EHU-ORAN
- Director of medical and care activities EHU-ORAN
- Vice-president of the CPRS of BIOCHIMIE OUEST
- Responsible for the Biochemistry module 2nd year Medicine
- University hospital teacher at the Faculty of Medicine of Oran, AHMED BENBELLA 1 University
- Team leader in the laboratory of research and cellular differentiation

Mail : saadisoulef31@hotmail.com

saadiamel.soulef@univ-oran1.dz

Tel : +213664002116

International Journal of Innovation Engineering and Science Research
(ISSN: 2581-4591)
www.ijiesr.com

Assessing The Sexual Profile Of Patients Treated For Localized Prostate Cancer.

Speakers: Pr A-S SAADI-OUSLIM [1,3], Dr F-Z MEGDAD [1,3], Dr M. ZENDJABIL [2,3], Mrs C. ZAOUI [3,4], Mr I-A OUSLIM[4], Pr T.SAHRAOUI[4]

1:Biochemistry Department EHU-ORAN,
2:Biochemistry Department CHUO,
3:Faculty of Medicine Oran Univ-1,
4:Faculty of Biology Univ-1

ABSTRACT

INTRODUCTION: Impotence is a common occurrence after irradiation. It occurs in 60 to 70% of patients [1]. In the PCOS study, 43% of patients who reported being sexually active before irradiation became secondarily impotent [2]. Erectile dysfunction occurs progressively over 2 to 3 years. The psychological and emotional impact of sexual changes is significant. Two-thirds of patients experience at least one of three repercussions: loss of masculinity, loss of self-esteem or performance anxiety.

OUR OBJECTIVE: To assess the sexual profile of patients irradiated for localised prostate cancer.

MATERIALS AND METHODS: Retrospective descriptive and analytical study, carried out in the biochemistry department of EHU-Oran, 89adult male patients with localized prostate tumors after radiotherapy from October 11, 2016 to June 11, 2021. All patients had an initial testosterone determination on a dry tube then 3 months after external radiotherapy (70-76 grays) with regular follow-up at 6, 9, 12, 18 and 24 months, on Cobas e411 ROCHE machine with 2 quality controls.
A questionnaire was sent to the patients to evaluate their sexuality and its variations according to the variations of the testosteronemia before and after the radiotherapy treatment.

RESULTS: After treatment 37 patients lost orgasm completely against 41 patients who kept it inconsistently. The interrelation of medical treatment and patient satisfaction was highly significant with a $p < 10\text{-}3$. Of the 89 patients in the series, only 71 patients (79.8%) agreed to take the medical treatment for their erectile dysfunction, orgasm and ejaculation disorders, only 44 patients were satisfied with their therapy and 27 patients were not satisfied due to several reasons including age, comorbidities, diabetes and the patient's psycho-affective state.

DISCUSSION: Testosterone levels at baseline have an important prognostic value for the subsequent assessment of sexual function and its evolution. A persistent decrease in sexual desire should lead to a search for a testosterone deficiency syndrome, and the recommendations of the learned societies involved make it possible to consider replacement therapy under certain conditions.
The variations in the mean values of testosterone are very significant and this at each control $p < 0.05$. We note a decrease in the mean values of testosterone in a gradual way since the control at 3 months, then 6 months, 9 months, 12 months, 18 months and 24 months in post radiotherapy and this value decreases in favour of the therapeutic response and the favourable evolution of the states of the patients but in the cases of too low values that influences the sexuality of the patients unfavourably because the higher the dose of irradiation is, the more the damage is important. The behaviour of the patients according to the absence of ejaculation varies strongly according to their age and this in a significant way $p < 10\text{ -}3$,

CONCLUSION: Protocols for the management of sexual difficulties in prostate cancer vary according to the type of carcinological treatment chosen. Their early implementation ensures the best chances of recovery. Assessment of sexuality prior to diagnosis is essential. Reconstruction of sexual function is possible and contributes greatly to the improvement of the patient's emotional state. The emotional and relational impact of prostate cancer is significant and should not be neglected.

Key words: Prostate cancer, radiotherapy, testosterone, sexual disorders, emotional state

FULL-TEXT

I. INTRODUCTION:

Treatment of prostate cancer with external radiotherapy and brachytherapy can damage nerve bundles involved in erection. The effects of radiotherapy on erection vary. The amount of radiation given to the prostate and the base of the penis (penile bulb) near the scrotum may affect the risk of developing impotence: the higher the dose of radiation, the greater the risk [1].
Impotence is a common occurrence after irradiation. It occurs in 60 to 70% of patients [2]. In the PCOS study, 43% of patients who reported being sexually active before irradiation became secondarily impotent [3]. Erectile dysfunction occurs progressively over 2-3 years and stabilises later, although 30-50% of men retain their usual erectile function at 5 years after external beam radiotherapy [4]. The main prognostic factors for the occurrence of erectile dysfunction are older age and the quality of erectile function before treatment. Other factors are also likely to play a role, such as the patient's vascular or psychological status [5]. As with surgery, a man who has undergone radiotherapy retains his sexual desire (libido) and ability to have orgasms [3].

The psychological and emotional impact of sexual changes is significant. Two-thirds of patients experience at least one of three impacts: loss of masculinity, loss of self-esteem or performance anxiety. Loss of masculinity affects the most patients (61.9%) [5, 6, 7]. This loss of masculinity could be the cause of relationship problems with women in their daily lives and a change in their intimate life and fantasies [4, 8, 9]. Low self-esteem and performance anxiety at the thought of having sex is reported by patients with rates reported in the literature (75% for low self-esteem [5,7,10], 28-70% for performance anxiety [7,11,12]). Therefore, a good assessment of a possible post-radiation sex life would give hope for a cure to patients and a better future.

OUR OBJECTIVE: To evaluate the sexual profile of patients irradiated for localized prostate cancer.

II. MATERIALS AND METHODS:

This is a retrospective descriptive and analytical study with retrospective collection, carried out in the biochemistry department of the EHU-Oran, in adult male patients with localized prostate tumors after radiotherapy from October 11, 2016 to June 11, 2021. The structures of origin are the urology service of the CHU-Oran, the EHU-Oran, the liberal practitioners and the radiotherapy services of the CHU-ORAN and the CAC.

Inclusion criteria	**Exclusion criteria**
age ≥ 50 years	
localized cancer without metastasis	**metastasized cancer**
TNM class: T0 to T2c N0M0	**TNM stages 3 and 4**
Gleason score lessthan 8	**Gleason score greater than 8**
radiotherapyprotocol	**patients who have undergone radical treatment (total prostatectomy).**
patients who underwent biopsy	
The presence of comorbidities does not exclude	

the patient	

All patients had an initial testosterone determination on a dry tube and then 3 months after external radiotherapy (70-76 grays) with regular follow-up at 6, 9, 12, 18 and 24 months, on a Cobas e411 ROCHE machine by electro-chemiluminescence. The assays are performed with quality controls PCU1 and PCU2.

A questionnaire was sent to the patients to evaluate their sexuality and its variations according to the variations of the testosteronemia before and after the radiotherapy treatment. Changes in testosterone levels were monitored in relation to sexual activity. The questions addressed to the patients were taken from questionnaires studied and validated by the different randomised studies and learned societies [13]

Distribution of patient treatment	**TREATMENT**			
	70 Gray		**76 Gray**	
	1st part	**2nd part**	**1st part**	**2nd part**
	50Gray	**20 Gray**	**56 Gray**	**20 Gray**
Number of patients	**24**		**75**	

Distribution of patients by treatment dose

Data collection:

- **Quantitative data**: expressed as: mean +/- standard deviation. T-test: to compare the means of the variables
- **Qualitative data**: Pearson's chi-square test (x 2) and the test of the reduced deviation with a significance threshold of α = 5%.
- **Multi-variate analysis**: Cox model: The final model included variables that were significant at P ≤ 5%. Linearity of quantitative variables was tested on Stata 12.Data were processed on Epi-info version 3.5.3 january 26,2011, and on SPSS version 20.0.

III. RESULTS :

1. Patients' orgasm status before and after radiotherapy treatment:

- Before treatment 18 patients had no orgasm, after treatment 17 of them lost it completely and only one kept it inconsistently.

- The 11 patients who had normal orgasms, after treatment 7 kept it and 4 inconsistently.

- Before treatment 60 patients did not have regular orgasms and 37 of them remained in this state, 20 lost it and only 3 recovered it.

2. Distribution of patients who received medical treatment for their sexual disorders according to their satisfaction :

The interrelationship between the use of medical treatment and the notion of patient satisfaction is highly significant with a $p < 10\text{-}3$. Of the 89 patients in the series, only 71 patients (79.8%) agreed to take medical treatment for their erectile dysfunction, orgasm and ejaculation disorders.

Of the 71 patients who took medical treatment only 44 patients were satisfied with their therapy and 27 patients were not satisfied due to several reasons including age, comorbidities, diabetes and the patient's psycho-emotional state.

3. Analysis of the patient questionnaire:

a- Follow-up through regular check-ups: 97.8% of patients (87 patients) felt followed and considered, while 2.2% (2 patients) felt neglected or even abandoned.

b- **Frequency of spontaneous erections after radiotherapy:** 76.4% (68 patients) had spontaneous erections allowing sexual intercourse against 23.6% (21 patients) who had lost it.

c- **Development of sexual desire after radiotherapy**: it increased for 1.1% (1 patient), remained the same for 67.4% (60 patients) and decreased for 31.5% (28 patients).

d- **Frequency of sexual intercourse after radiotherapy**: it changed differently for the patients. 1.1% (1 patient) increased, 53.9% (48 patients) remained the same and 43.8% (39 patients) decreased.

e- **Frequency of orgasms before radiotherapy treatment**: 12.4% had orgasms with every intercourse (11 patients), others 67.4% not with every intercourse (60 patients) and 20.2% had none (18 patients).

f- **Frequency of orgasms after radiotherapy treatment:** 41.6% lost it (37 patients), 11.2% retained it (10 patients) and 47.2% retained it but not at every intercourse (42 patients).

g- **Orgasm intensity after radiotherapy**: identical in 30.3% of patients (27 patients), less intense in 69.7% (62 patients) and none of the patients had a more intense orgasm

h**- Evaluation of urine loss during sexual intercourse**: 5.6% (5 patients) were so embarrassed that sexual intercourse was avoided, 68.5% (61 patients) were embarrassed but did not prevent sexual intercourse and 25.8% (23 patients) were not embarrassed and allowed the patients to have a normal life.

i**- Impact of lack of ejaculation on patients**: very bothersome to the point of avoiding sexual intercourse in 1.1% (1 patient), bothersome but does not prevent intercourse in 58.4% (52 patients), and not bothersome at all in 40.4% (36 patients).

j- **Satisfaction with the medical treatment**: 71 patients who received the treatment among them :

- 62% (44 patients) were satisfied with the treatment
- 38% (27 patients) were not satisfied

4. **Qualitative analysis: Study of the impact of radiotherapy on the frequency of sexual intercourse before and after treatment:**

	Beforetreatment	Aftertreatment	P
NO	**20.2**	**41.6**	**< 0.05**
YES	**12.4**	**11.2**	**NS (0.81)**
MORE OR LESS	**67.4**	**47.2**	**< 0.05**

Orgasm frequencies before and after radiotherapy

IV. DISCUSSION:

Testosterone is a male hormone that determines male sexual characteristics, sexual drive and erection. This hormone is produced by the testicles and to a lesser degree by the adrenals. The erection is the result of the presence of testosterone and stimulation of the brain [4].

Orgasm is the climax of sexual pleasure in both men and women. In men it is associated with ejaculation [4].

It is perfectly possible to have an orgasm without emitting sperm, which is the case for young people before puberty or for some men who have had prostate surgery (retrograde ejaculation) [5].

Testosterone levels at the initial work-up have an important prognostic value for the subsequent assessment of sexual function and its evolution. A persistent decrease in sexual desire should be investigated for a testosterone deficiency syndrome. In the case of a proven biological deficiency and clinical signs, the recommendations of the learned societies involved allow the consideration of replacement therapy under certain conditions [14].

Evaluation of testosterone levels after 24 months since cessation of treatment also allows assessment of sexuality and identification of sexual disorders. For some patients, disorders appear very quickly during irradiation and their prevalence increases during the first three years.

Only 25% of men with normal erectile function before radiation therapy have a chance of maintaining it 5 years later. Erectile dysfunction stabilises thereafter, affecting 50% of patients in series with radiotherapy alone, and more than 70% when temporary hormone therapy is combined [5,12]. In the latter case, desire disorders are added to the dyserection and dysorgasmia and are not always regressive when hormone therapy is stopped [13,15].

Indeed, the variations in mean testosterone values are highly significant at each control $p < 0.05$. A gradual decrease in the average testosterone values is noted from the 3 month control, then 6 months, 9 months, 12 months, 18 months and 24 months post radiotherapy and this value decreases in favour of the therapeutic response and the favourable evolution of the patients' states but in the cases of too low values this influences unfavourably the sexuality of the patients because the higher the dose of irradiation the more the damage is important. Radiotherapy can have a deleterious effect on the exocrine (azoospermia) and endocrine (hypogonadism) functions of the testicles. The radiation-induced lesions on the testicles are dose-dependent (disturbance of testosterone, elevation of FSH, alteration of spermatic characteristics), in intensity and duration [10].

According to our study; The frequency of sexual intercourse as a function of testosterone in post radiotherapy is very different with a significant significance $p = 0.008$. The frequency of sexual intercourse therefore varies according to the treatment and also varies according to the testosterone value. In total of the 89 patients 53.9% (48 patients) had maintained normal sexual frequency, 44.9% (40 patients) had decreased sexual frequency and only 1.1% (1 patient) had increased frequency which is probably related to age. Age and diabetes are the main risk factors. Age is a very important parameter in the modification of the frequency of sexual intercourse after radiotherapy, with a very significant difference $p < 10^{-3}$. The older the patient, the more frequent intercourse is reduced. The existence of nocturnal erections before radiotherapy is a good prognostic factor [5, 15] as is younger age.

The intensity of sexual intercourse also varied significantly with age with a highly significant difference $p < 10^{-3}$. Of a total of 89 patients, 69.7% had a decreased sexual intensity, 30.3% had the same sexual intensity as before treatment. All of our results are consistent with the literature and other studies, as the younger the age of the patients, the better the retention of sexual intensity.

After prostatic radiotherapy, hypogonadism and testicular atrophy have been reported 3 to 8 years after irradiation [11]. Testicular irradiation can also lead to alterations in sperm genetic material, especially during the first year [16]. Medically assisted reproduction using epididymal aspiration or testicular extraction after radiotherapy may be compromised or at risk of fetal malformation.

The behaviour of the patients in relation to the absence of ejaculation varies strongly according to their age and this in a significant way $p < 10^{-3}$, on the 89 patients we have 58.4% or the absence of ejaculation is annoying but does not prevent a more or less normal sexuality

Concerns about sexual deficiency are at the forefront of distress for a large majority of patients [17], and 68% of them are even willing to sacrifice part of their 5-year survival chances in exchange for maintaining their sexual function [13]. The behaviour of patients in relation to the absence of ejaculation varies significantly with their age ($p < 10^{-3}$). Of the 89 patients, 58.4% have an absence of ejaculation that is bothersome but does not prevent a more or less normal sexuality, 40.4% have an absence of ejaculation that does not cause any discomfort, and only 1.1% have an absence of ejaculation that is very bothersome and poses a major problem. The younger the age of the patients, the less problematic the absence is, although they still lead a normal life. But the older the patient is, 65 years, the more embarrassing it is and the more it causes a big problem of identification and relationship in these patients, this is what all the studies show. In fact, ejaculation disorders have little or no repercussions on patients, but the older they get, the more problematic it becomes ($p = 0.008$).

The questionnaire sent to the patients in order to analyse their sexuality and its variations according to the variations in testosteronemia before and after treatment. The analysis of the testosteronemia averages at each control where the variation is very significant $p < 10^{-3}$. The kinetic parameters of testosterone evolution are decisive prognostic criteria for the assessment of the sexuality of the patients and the identification of future sexual disorders in particular.

Before radiotherapy the patients had orgasms in different ways, some 12.4% had orgasms with every sexual intercourse, others 67.4% did not have orgasms with every sexual intercourse and finally 20.2% had no orgasms.

Since the end of radiotherapy, the patients' orgasms have changed: 41.6% have lost their orgasms, 11.2% have retained their orgasms and 47.2% have retained their orgasms but not with every act of intercourse. Similarly, the intensity of orgasms remained the same in 30.3% of patients, less intense in 69.7% and none of the patients had a more intense orgasm.

The comparison of the frequency of orgasms before and after radiotherapy treatment has a very important significance:

- Those who lost it the difference is highly significant with $p < 10^{-3}$
- Those who kept it without modification the difference is not significant
- Those who kept orgasms more or less regularly the difference is very significant with $p < 10^{-3}$

Comparing our results (erectile dysfunction, orgasm and sexual function), all these results are consistent with the different studies [13].

Of the 71 patients who took medical treatment only 44 patients were satisfied with their therapies and 27 patients were not satisfied due to several reasons including age, comorbidities, diabetes and the patient's psycho-emotional state.

In case of failure of iPDE5, intra-cavernous injections, vacuum or implants can be proposed [18].

V. CONCLUSION:

Protocols for the management of sexual difficulties related to prostate cancer vary according to the type of carcinological treatment chosen. Their early implementation ensures the best chances of recovery. The evaluation of sexuality prior to the diagnosis of prostate cancer and its various parameters is essential. It enables the information to be personalised and early therapeutic solutions to be envisaged, adapted to the patient's needs. It also allows other risk factors that may affectfuture sexuality to be taken into consideration.
The reconstruction of sexual function is possible and contributes greatly to the improvement of the patient's emotional state. The emotional and relational impact of prostate cancer is significant and should not be overlooked. The risk of anxiety and depressive disorders is high, and concerns about future sexuality are at the forefront of emotional disturbance and distress.

Erection is not the only sexual parameter profoundly affected by prostate cancer. Problems with orgasm, ejaculation, libido, continence and infertility all contribute to the degradation of self-image and the feeling of loss of masculine identity. Reviving the erection is not enough, masculinity itself must be redefined and rebuilt.

It is important not to hesitate to offer the patient temporary forms of alternative sexuality, allowing the couple to maintain carnal and emotional intimacy, while waiting for the erection to become possible again. Pharmacological treatments are the key element of erectile rehabilitation, which is essential to restore sexual function.

Conflicts of interest: the authors declare no conflict of interest

Références :

[1] Peeters ST, Heemsbergen WD, van Putten WL, et al. Acute and late complications after radiotherapy for prostate cancer: results of a multicenter randomized trial comparing 68 Gy to 78 Gy.Int J RadiatOncolBiolPhys 2005;61:1019-1034.

[2] M.Wisard. Cancer et Sexualité Masculine Rev Med suisse 2008,4: 2613.23.

[3] Pilepich MV, Winter K, Lawton CA, et al. Androgen suppression adjuvant to definitive radiotherapy in prostate carcinoma--long-term results of phase III RTOG 85-31. Int J Radiat OncolBiolPhys 2005;61:1285-1290.

[4] Peneau M, Staerman F. Altération de la fonction sexuelle dans le traitement du cancer de la prostate localisé. ProgUrol 2006:16:721-30.

[5]- LAUREAT S. Physiologie de la reproduction masculine, physiologie humaine 1° édition 10- KOURY S , WRYGHT F .

[6] V.Delmas, X.Durand, L. Boccon-Gibod, Bases anatomoques du curagelymphonodal dans le cancer de prostate. ProgUrol 2004-252.

[7] T. Seisen, M. Roupret, A. Faix, A. Droupy. La prostate : une glande au carrefour urogénital.ProgUro 2012-S2-S6- SUPP1.

[8] L.Salomon, D.Azria, C.Bastide, P.Benzedoc, L.Courier, F.Conrad, D.Eiss, P.Eschwige, N.Gaschigard, C.Hennequin, V.Molinié, P.Mongiat- Artus, J-L.Moreau, Michel.Pineau, M.Peyromane, V.Ravery, X.R ebillard, Les membres du CCAFU. Progrès en urologie, vol 20, n° S4 pages 251-271 novembre 2010. Recommandations en onco-urologie 2010 Cancer de la prostate..

[9] B.Chauvet, R.Oozer, P.BeyD.Pontvert, M.Bolli. Vol 3 – n° 5 page393-406 Radiothérapie conformationnelle des cancers de la prostate.

[10] Seftel AD, Martin M, Kloner RA, Stanley EA. Office evaluation of male sexual dysfunction. Urol Clin N Am 2007:34:463-82.

[11] C.Roy, V.Servis, B.Sarrer. Vol 87 n°2 C2 pages 244 -256 journal de radiologie.Le point sue…. Les thérapeutiques et la surveillance dans le cancer de la prostate et leur implication sur l'imagerie.

[12] L.Quero, P.Mongiat-Artus, V.Ravery, V.Hennequin, C.Maylin, F.Desgeandchanp, C.Hennequin. Progrès en urologie vol 13 – n° 4 PAGES 267-275

[13] M.- H. Colson, E. Lechevallier, J.- J. Rambeaud, J.- C. Alimi, A. Faix, G. Gravis, J.- M. Hannoun-Levi, H. Quintens, X. Rébillard, S. Droupy. Sexualité et cancer de la prostate. Progrès en urologie (2012) 22, S72-S92.

[14] Cancer et sexualité masculine. Rev Med Suisse 2008;4:2618-2623

[15] Christian Carrie, Pascal Pommier. Vol 9 n°6-7 pages 379-381 cancer- radiothérapie. Radiothérapie post-opératoire immédiate ou différée dans le cancer de la prostate.

[16] Bolla M, Collette L, Blank L, et al. Long-term results with immediate androgen suppression and external irradiation in patients with locally advanced prostate cancer (an EORTC study): a phase III randomised trial. Lancet 2002;360:103-106.

[17] Rullier E. Conséquences fonctionnelles de la chirurgie d'exérèse rectale. Quelle est l'influence des séquelles sur la qualité de vie ? Le courrier de proctologie 2002;2:53-5.

[18] M.- H. Colson, E. Lechevallier, J.- J. Rambeaud, J.- C. Alimi, A. Faix, G. Gravis, J.- M.Hannoun-Levi, H. Quintens, X. Rébillard, S. Droupy. Sexualité et cancer de la prostate. Progrès en urologie (2012) 22, S72-S92.

[19] Pilepich MV, Winter K, Lawton CA, et al. Androgen suppression adjuvant to definitive radiotherapy in prostate carcinoma--long-term results of phase III RTOG 85-31. Int J Radiat OncolBiolPhys 2005;61:1285-1290.

International Journal of Innovation Engineering and Science Research
(ISSN: 2581-4591)
www.ijiesr.com

Assessment of Electric Power Consumption of Electric Appliances of Households Utilising the Data from Smart Meter

Kofi Fofie
Department of Computer Science
Kwame Nkrumah University of Science and Technology (KNUST)
Kumasi, Ghana,
Serwaa Kesse Girls' Senior High School, Duayaw-Nkwanta, Ghana.

Prof. Michael Asante (*Supervisor*)
Department of Computer Science
Kwame Nkrumah University of Science and Technology (KNUST)
Kumasi, Ghana

ABSTRACT

Smart grid for smart distribution systems will need smart technology and smart devices for reliability and elasticity of power distribution systems. The smart meter is one of these devices which can record, measure and transmit the power consumption of consumers and also gather enough and valuable information for the distribution operators which can be used for monitoring of systems operations. This paper aims at assessing the power consumption of electric appliances of household consumers and performance of the smart meter. A comprehensive survey is conducted on the data gathered by the smart meter. The data is analyzed using a statistical tool and theMean Absolute Error (MAE), Correlation Coefficient (R), Root Mean Square Error (RMSE) and Mean Absolute Percentage Error (MAPE) values are determined.

Keywords- *Smart meter, grid, elasticity, power, consumption, monitoring, distribution.*

I. INTRODUCTION

The single distribution transformer dispatches lower voltage to varied customers depending on the number of customers at a particular location. Reducing high voltage from the main lines for the utilization of the customer who uses different loads is very complex and therefore an efficient distribution system to manage the distribution of the voltage in order to achieve an optimal service or delivery is essential. There is therefore the need to implore the use of Distribution Automation and smart distribution metering to manage the distribution of electricity at the lower voltage which can be utilized by the consumer or the customer.

Smart distribution metering is the system of electrical device that dispatches the correctand required electrical signal or load to a user or consumer and when used, the smart distribution meter receives the response of consumption and then record and convert the quantity consumed into price data. Smart distribution meter makes historical consumption of power available and it helps both the consumer and the supplier in the efficient management of power. It helps the supplier to have a deep and accurate knowledge of the power consumption of the consumer, and which further gives an insight of energy demand forecasting and as a result there is an improvement of network maintenance and planning[1]. Smart meter helps in detecting fraud consumption of energy [2] and the consumer can use the consumption pattern for better planning in order to manage and save power consumption. Consumers records of consumption can be studied based on each electrical device or appliance used

and therefore the use of the manual and conventional way of dealing with power distribution to the households is very difficult because of the gathering of large and complex amount of information or data that is used in calculations and hence the need for distribution automation and some machine learning and statistical tools. The Distribution Automation comprises the automation which is used in the planning, engineering, construction, operation, and maintenance of the distribution power system, including interactions with the transmission system, interconnected distributed energy resources (DER), and automated interfaces with end-users [3]. When Distribution Automation and smart grid technologies are employed in power distribution system, power flows efficiently and restores quickly when the power supply is interrupted.

According to [4], smart grid are more efficient electrical networks which are reliable and make way for electricity to be generated and distributed in a friendly environment thereby reducing the gap between demand and supply. The utility providers must adopt the smart grid technology to empower the efficiency, reliability and resiliency of the distribution system. When the demand of electricity by customers is properly estimated and predicted, it helps the service providers, utility owners, power system managers, energy planners and system operators to plan well and can determine the maximum consumption of a customer, hence detect and predict the true power consumption of the customer. Smart distribution will need smart meters and according to the U.S. Department of Energy's report on smart grid system, it is estimated that about sixty-five million smart meters have been installed by 2015 [5] and also by 2020, it is expected that about 830 million of smart meters would be deployed worldwide [6]. The smart meters are able to accumulate greater amount of data that is able to give enough information to monitor operational systems in almost real time [7]. A smart meter is a two-communications electronic device that transmit the data of consumers' energy consumption and system operation information to the distribution operating center automatically [8]. It is very important to get smart meters which will optimize the distribution performance and as distribution grid is becoming very complex, smart meters are needed for recording and measuring of electrical power distribution in the household where distribution will not be interrupted and the user can be provided with very vital information about power consumption [9]. According to [10], it is very important to have smart distribution systems that can perform efficiently without any interruption and can also provide to users the necessary information about the consumption of power and its quality, and smart distribution systems will need smart meters for power distribution. This paper focuses on the assessment of the smart meters in smart distribution and statistical tools are used to assess the performance of the smart meter, and it is organized in sections with introduction as the first section, section two talks about the methodology, section three describes how the design is done and section four as the conclusion.

II. METHOLOGY

This paper aims at assessing the power consumption of electric appliances of household consumers base on the usage of the smart meter. Sample of consumers were randomly selected and interviewed on the various appliances used. The wattage of these various appliances were recorded as well as the estimated time or hours of usage of the appliances. The monthly consumption was also recorded and the consumption behavior of the consumer analyzed using statistical tool. The Mean Absolute Error (MAE), Mean Square Error (MSE), Root Mean Square Error (RMSE) and Mean Absolute Percentage Error (MAPE) were calculated. MATLAB-Simulink programing environment was used to simulate the distribution of power through these appliances.

Table 1-Wattage of various appliances and the estimated hours and KWH used per month.

APPLIANCES	APPLIANCE'S WATTAGE(W)	ESTIMATED HOURS/MONTH	ESTIMATED KWH/MONTH
Fridge	80	330	26.4
Fluorescent bulb	40	300	12.0
Incandescent bulb	60	300	18.0
Radio	5	360	1.80
Fan	80	450	36.0
TV	40	240	9.60
Iron	1000	10	10.0
AC	900	210	189.0
Hair Dryer	1000	360	360.0
Computer	50	360	18.0
Heater	1500	60	90.0
Bulb	11	360	3.96

Table 1-Energy consumption and simulating time.

PERIOD	ENERGY(KWH)	SIMULATION TIME(SECONDS)
1	48.5	9.70
2	72.5	14.50
3	85.5	17.00
4	97.0	19.40
5	45.0	9.00
6	50.8	11.05
7	75.7	11.30
8	80.4	11.95
9	72.6	19.50
10	96.8	19.30
11	94.9	16.90
12	100.55	19.81

Fig. 1- shows a picture of a smart meter fixed on a pole.

III. DESIGN

Fig. 2 shows the architecture of electrical power distribution through the electrical appliances in a household, where the blue color in rectangular shapes show the smart meter, smart switch and the various appliances or devices and the orange color in round shapes show the switches or control that turn the electric current on and off.

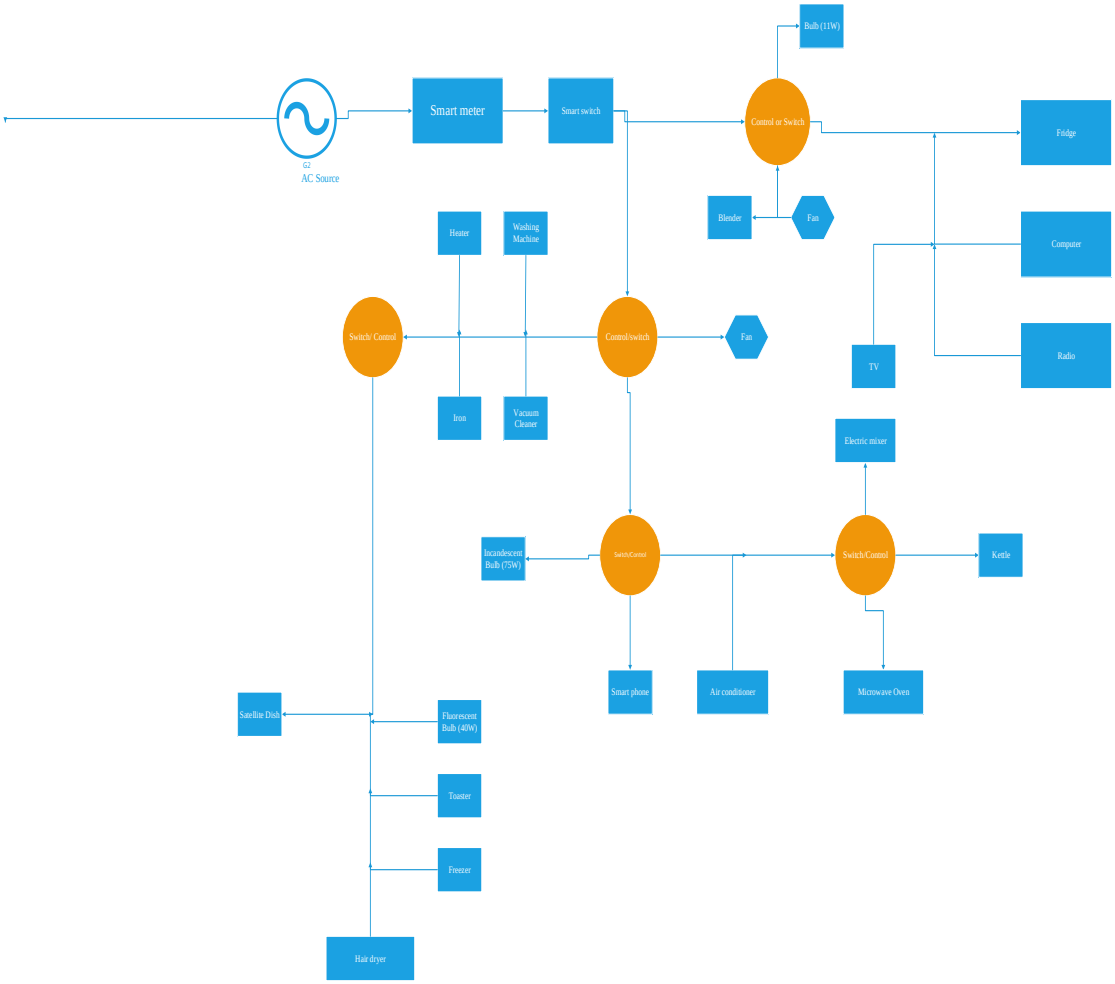


Fig. 2-shows architecture of electrical power distribution in a household.

The signal or the Alternating Current (AC) voltage from the source connects to the smart meter through to the smart switch and it is distributed to the various components according to the needs and the capacity of each component or device. In the distribution process, there is decision on which amount of signal or power should be dispatched to each component and which amount should go back to the source. This is an "Information Intelligence".

The AC power distribution involves a lot of variables such as the load voltage V (t), load with resistance R only or inductance X_L or capacitance X_c. The inductance and the capacitance are put together as reactive power.The instantaneous power in to the load is given as

$$P(t) = v(t)i(t) = \frac{v^2(t)}{R} \quad (1)$$

$$P(t) = \frac{V_m^2}{R}\cos^2 \omega t$$

The average instantaneous power is given as:

$$P(t) = \frac{V_m^2}{2R}(1 + \cos 2\omega t) \quad (2)$$

$$P = \frac{1}{T}\int_0^T p(t)\partial t$$

$$V(t) = V_m \cos(\omega t + \varphi) \quad (3)$$

$$i(t) = I_m \cos(\omega t + \psi) \quad (4)$$

$$P = \frac{1}{T}\int_0^T v(t)i(t)\partial t$$

$$P = \frac{1}{T}V_m I_m \int_0^T \cos(\omega t + \varphi)\cos(\omega t + \psi)\,\partial t \quad (5)$$

$$P = V_{rms}\, I_{rms} \cos\theta \quad (6)$$

The expression (6) determines the average power delivered to the circuit element or device[11].
Where P is the average power delivered to the load, V_{rms} is the root-mean-square-voltage, I_{rms} is theroot-mean-square-current, $\cos\theta$ is the power factor, where θ is the phase angle which is the measure of how much the applied voltage leads or lags the current in the alternating current (AC) circuit.
The Mean Absolute Error (MAE), Correlation Coefficient (R), Root Mean Square Error (RMSE) and Mean Absolute Percentage Error (MAPE) were determined using the following equations:

$$MAE = \frac{1}{n}\sum_{i=1}^{n}|A_i - P_i| \quad (7)$$

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n}(A_i - P_i)^2}{n}} \quad (8)$$

$$MAPE = \frac{1}{n}\sum_{i=1}^{n}\frac{|A_i - P_i|}{A_i}x100 \quad (9)$$

Where A_i are the actual values and P_i are the predicted values. These performance indices are used to compare the actual and the predicted values. A graph of consumption in KWH against the

simulation time is shown in Fig. 2 which shows the model and the coefficient of correlation R.The surface view in three-dimension of the hourly, daily and monthly consumption is shown in Fig. 3.

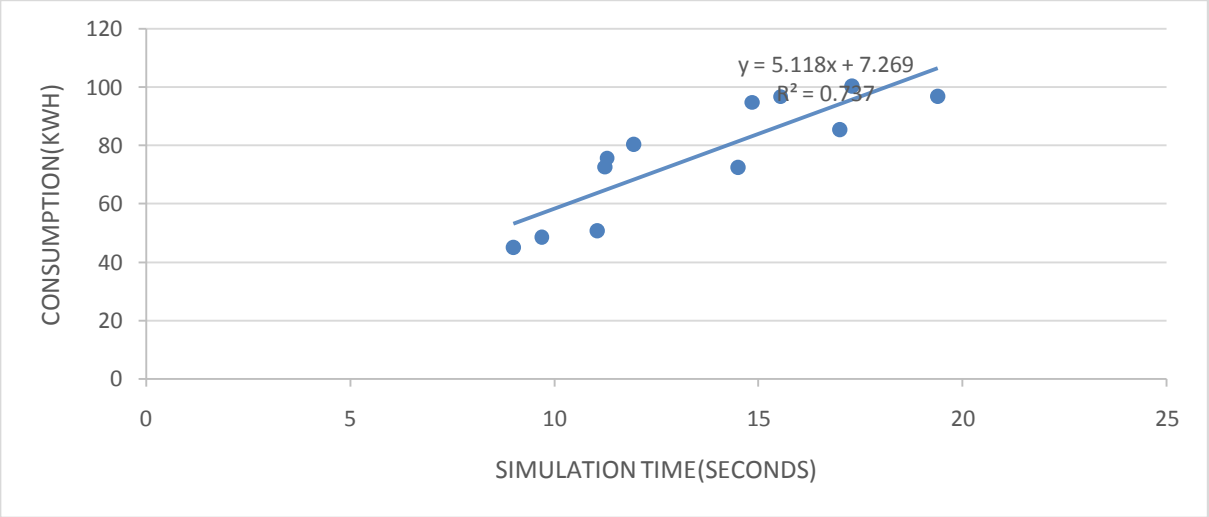


Fig. 2-shows graph of consumption (KWH) against simulation time.

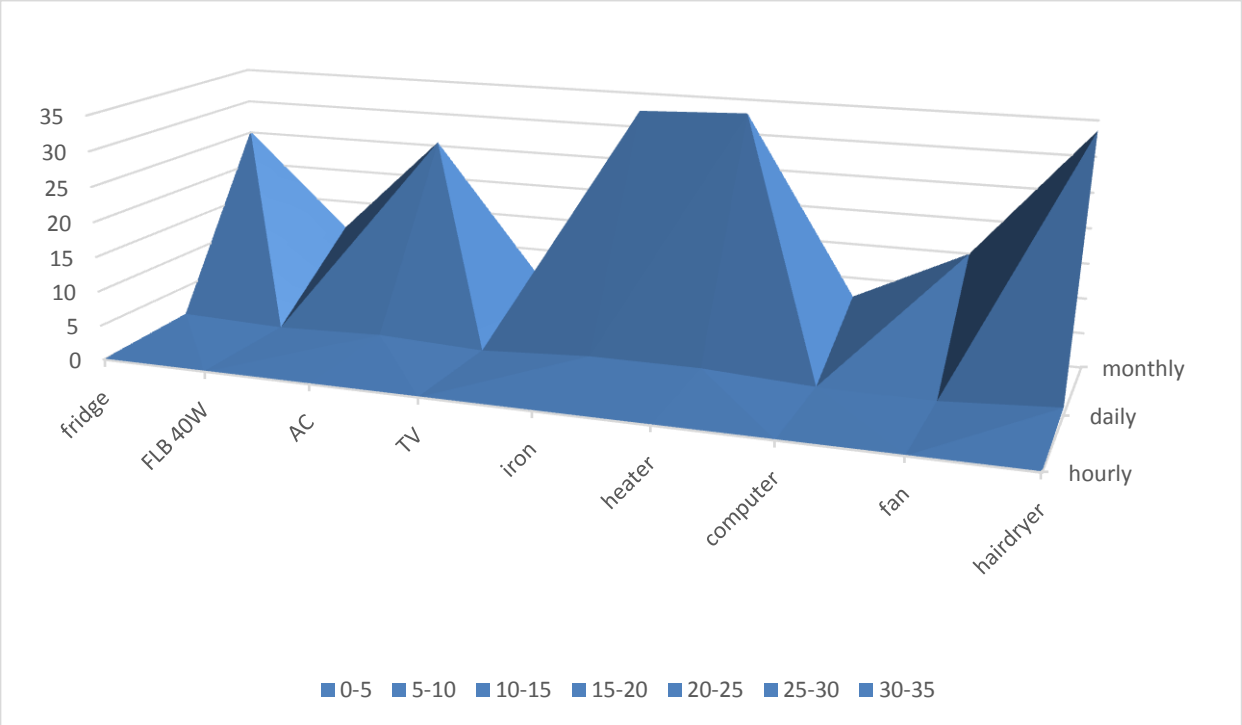


Fig. 3-shows the view of the hourly, daily and monthly consumption of the various devices.

Table 2-Hourly, Daily and Monthly consumption of the various appliances.

APPLIANCES	HOURLY(KWH)	DAILY(KWH)	MONTHLY(KWH)
Fridge	0.06	0.84	25.2
Fluorescent bulb (40W)	0.020	0.24	7.20
Incandescent	0.030	0.36	10.8

bulb(75W)			
Radio	0.010	0.12	3.60
Fan	0.050	0.50	15.0
TV	0.020	0.20	6.00
Iron	0.090	1.08	32.4
Air Conditioner	0.071	0.852	25.56
Hair Dryer	0.080	1.120	33.60
Computer	0.020	0.24	7.20
Heater	0.100	1.10	33.00
Bulb (11W)	0.010	0.12	3.60

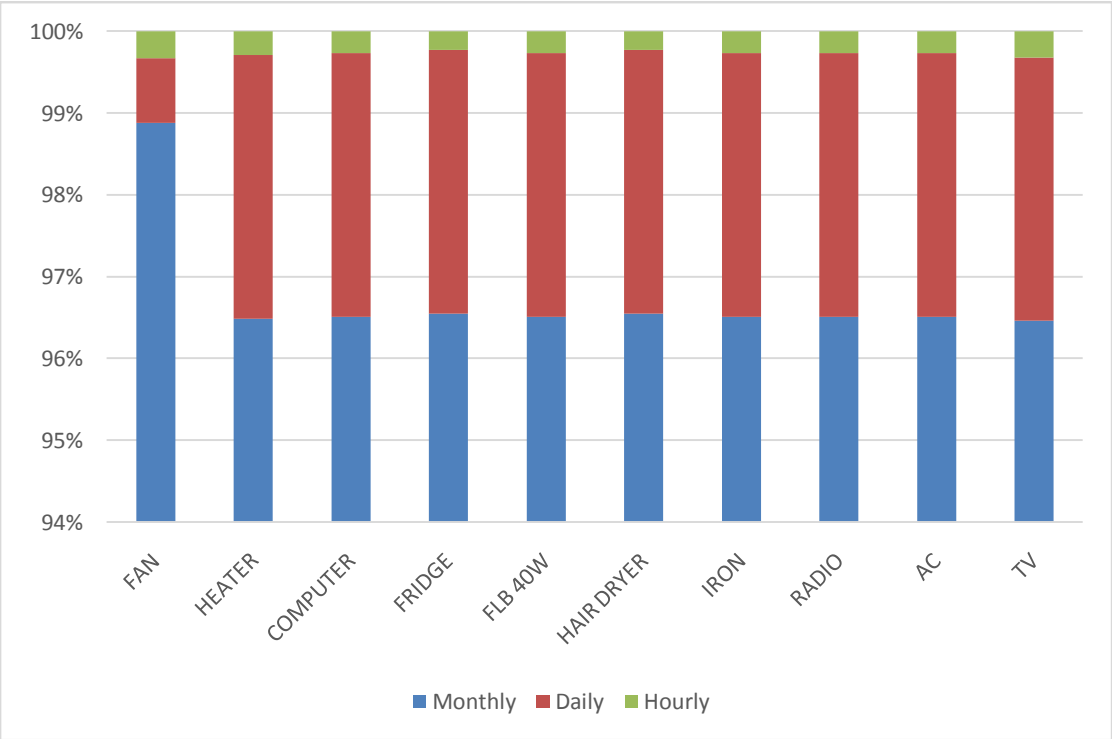


Fig. 3- shows the consumption (kwh) of the appliances in hourly, daily and monthly.

From Fig. 3, it is realized that the monthly consumption which shows in blue color has the highest percentage for each appliance, follows by the daily consumption shown in red color and the least is the hourly consumption which shows green. The smart meter can measure or take record of the smallest consumption and accumulate greater amount of data which can give sufficient or required information to monitor operational systems in almost real time [7], and it can also help the consumer to plan well to save energy in power consumption.

Table 3-Excel workbook showing how MAE, RMSE and MAPE were calculated.

Period	A	P	A-P	ABS(A-P)	(A-P)^2	|A-P|/A
1	48.52	56.92	-8.4	8.4	70.56	0.173124
2	72.54	81.48	-8.94	8.94	79.9236	0.123242
3	85.51	94.28	-8.77	8.77	76.9129	0.102561
4	97.06	106.56	-9.5	9.5	90.25	0.097878
5	45.03	53.33	-8.3	8.3	68.89	0.184322
6	50.82	63.83	-13.01	13.01	169.2601	0.256002
7	75.75	65.1	10.65	10.65	113.4225	0.140594
8	80.47	68.43	12.04	12.04	144.9616	0.149621
9	72.68	64.85	7.83	7.83	61.3089	0.107733

As shows in table 3, the absolute values of the difference between the actual values and the predicted values are a bit big values and that affect the values of the MAE, RMSE and MAPE. Figure 4 shows the performance values against the performance parameters or indices

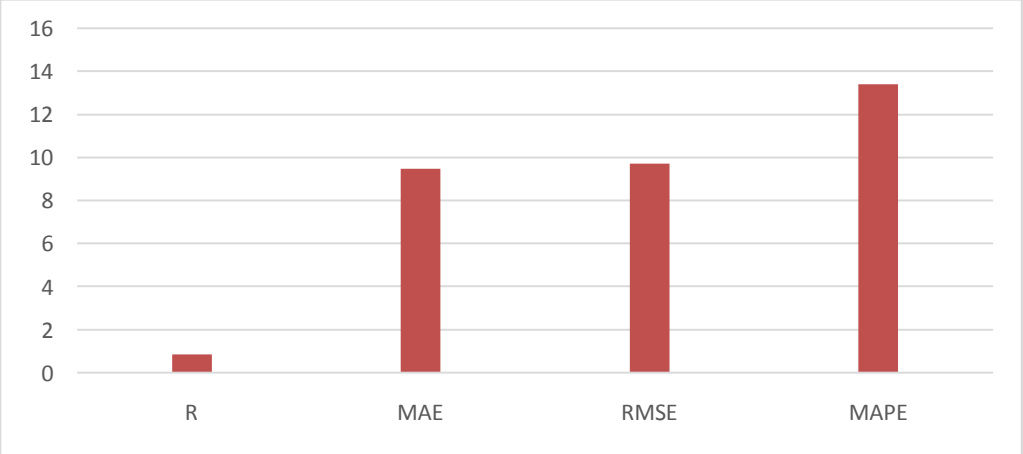


Figure 4, performance parameters or indices.

IV. CONCLUSION

Smart meters in smart distribution help to gather relevant information for both distribution operators and consumers which can manage in monitoring and preserving power consumption. This paper studied the performance of the smart meter using statistical tools to examine the data accumulated by the device over some period of time, that is from January to December. Some of the appliances such as blender, toaster, and microwave oven were not very often used and the usage of the fan and water heater depended on how cold or hot the weather was. At high temperature, the fan and the air conditioner were largely used but the water heater was not often used and vice versa. The MAE, R, RMSE and MAPE for a whole year were respectively determined to be 9.4867, 0.86, 9.7203 and

13.40238. The absolute values of the deviations or errors are a bit high and that affect the performance indices such as the MAE, RMSE and MAPE. This shows that the smart meter performs better and actually measure and record the real consumption if the distribution of power is constant and uniform. There are several problems associated with distribution of power such as faults, supply and demand imbalance, system of equipment which are old and weak and such vulnerability which cause unpredictable power outage for a long time affect the power consumption pattern of consumer [12]. This mean that the true consumption can be predicted ifthe power distribution is constant and reliable. The linear regression which is a conventional machine learning algorithm is practically used to make prediction of linear functions, and therefore the nonlinear signal could not be considered. The percentage of hourly, daily and monthly consumptions were determined and that also shows that the smart meter can collect data at the lowest minutes and accumulate it over time which can be used in monitoring power consumption, efficiency and network planning and management. It would be better that more smart meters are installed by the utility providers that will help in efficiency, reliability and resiliency in distribution system.

REFERENCES

[1] F. S.N., D. R.C., S. M., C. M. and S. S., "Computational intelligence Approaches for load forecasting in smart energy management grids: state of the Art, Future Challenges, and Research Directions.," Energies, vol. 11, no. 596, 2018.

[2] V. G. R., J. S. and 9. 1.-9. Wilhite R.. 2006, " Smart Metering," Leonardo-Energy Org, vol. 9, pp. 1-9, 2006.

[3] P. X. Y. M. z. G. Y. W. J. Y. X. X. Xuesong Zhou, "An overview on distribution automation system," in Chinese Control and Decision Conference (CCDC), 2016.

[4] V. K. Fikirte Zemene, "Survey on Machine Learning based Electric Consumption Forecasting using Smart Meter Data," International Journal of Computer Applications, vol. 180, no. 6, pp. 46-52, 2017.

[5] h. s. g. s. r. 2014., "http://energy.gov/sites/prod/files/2014/08/f18/ smart grid system report 2014.," 18 August 2014. [Online]. Available: http://energy.gov/sites/prod/files/2014/08/f18/ smart grid system report 2014.. [Accessed 18 August 2014].

[6] Telefonica, "m2m.telefornica.com," 2014. [Online]. Available: https://m2m.telefonica.com/multimedia-resources/the-smart-meter-revolution-towards-a-smarter-future. [Accessed 31 January 2014].

[7] C.-C. L. a. Y. X. Yazhou Jiang, "Smart Distribution Systems," MDPI, no. 9, 2016.

[8] S. Depuru, L. Wang and V. Devabhaktuni, " smart meters for power grid: challenges, Issues, Advantages and Status," Energies, vol. 15, pp. 2736-2742, 2011.

[9] S. Kabunda, "The Smart Switch and its supporting role in Smart grids," Engerati, 2015.

[10] S. S. Ali, "Switching Gears for Smart Distribution," Electrical and Power Review Magazine, 7 June 2018.

[11] R. L. S. J. B. Sergey N. Makarov, "Practical Electrical Engineering," Springer International Publishing, Switzerland, 2016.

[12] A. R. Abulwafa, "Smart Distribution System Design: Automation for Improved Reliability.," Global Journal of Researches in Engineering, vol. 16, no. 7, 2016.

[13] F. S.N., D. R.C., S. M., C. M. and Shamshirband S. in Computational intelligence Approaches for load forecasting in smart energy management grids: state of the Art, " Future Challenges, and Research Directions.," Energies 2018, 11, 596,, vol. 11, no. 596, 2018.

International Journal of Innovation Engineering and Science Research
(ISSN: 2581-4591)
www.ijiesr.com

Pragmatic Measures for Attracting Youths to Construction crafts Skills vocation as means to tackle Construction industry Labour shortage

Nzeneri, Oluchukwu Precious-favour, Nkeleme Emmanuel Ifeanyichukwu, Diogu Elizabeth Obianuju, Kenkwo Franklyn Chukwujike, Chukwudi Stanley Ozoh,

[1, 2, 4] *Department of Building, Federal University of Technology Owerri, Imo State, Nigeria*
[3,5] *Department of Architecture, Federal University of Technology Owerri, Imo State, Nigeria*

ABSTRACT

The reason for the progressive construction industry labour shortage is not too far from the fact that the youth who should take up the skills from the older generation have little or no interest in the construction craft skill vocation. Thus, this study was conducted to identify pragmatic measures for attracting youths to construction skills vocation using South-East Nigeria as a case study. It was effected with the use of intense literature review and structured questionnaires distributed mainly to the teaching staff of vocational/technical schools, and construction professionals in southeast Nigeria. Data collected was analysed using the SPSS version 20.0. Results revealed that the most pragmatic measure to attract youths in the area is to make craftsmen's wages attractive (Mean=4.63,). Similarly, skills and vocational training should be made free in the area (Mean = 4.57,) 'properly fund technical/vocational education (mean=4.39), ranked second and third respectively. Consequently, the study concludes that, in other to achieve sustainable construction activities, youths need to be attracted to take up a career path in construction. Thus, improved wages for craftsmen/artisans and, making skills acquisition and vocational training free are strongly recommended.

Keywords: Pragmatic measures, Construction crafts skill vocation, Labour Shortage

I. Introduction

Construction, as in other production processes, (Oyegoke, McDermott, Aouad, and Cleary, 2009) involves a process of transforming inputs into outputs by using necessary resources. These resources are accumulated stocks of means of production and overall product performance. Thus, the effectiveness of the construction industry depends on among other factors, the quality, and condition of its workforce (Abdullahi, Anum, Adole, and Williams 2015).

Skills have been one of the most important issues in the construction industry, and since the construction methods are largely primitive; hence the necessity of a labor-intensive workforce (Oyegoke *et al*., 2009). Moreover, the fact that the structure of the industry is highly fragmented entails the need for many different skill sets. A skill is an ability to perform a productive task at a certain level of competence (Bilau, Ajagbe, Kigbu, and Sholanke, 2015). It is associated with a particular task; hence a person who does not possess such a skill is unlikely to be able to carry out such a task or will be less productive than somebody who does possess this skill. Skills are often associated with qualification and its acquisition through formal and informal training and on-the-job experience (Darren, Mark, and Christopher, 2012).

Skilled labor plays a very essential role in the survival and development of the construction sector (Medugu, Rafee, Bustani, Bala, Abdullahi & Mbamali, 2011; Rafee, 2012), and in the practical realization of any building project (Iro, Inuwa and Dantong, 2013). They are mostly engaged in the technical aspect of building products, and at the management, level serve as frontline managers (supervisors); giving the role of interpreting the company policies into the practical realization of the organizational goal of the employer. They are operatives who contribute skillfully with their hands in the practical realization of a project in the construction industry. Unfortunately, there is a short supply of these technically skilled craftsmen which adversely affects productivity, work quality, projects duration, and overall organizational profit (Agbola, 2005; Fagbenle, 2004; Onibokun, 2002). On this note, this study attempts to identify the effective measures for attracting youths to construction skills crafts to ensure sustainability in the training and supply of indigenous skills in the construction industry.

II. Literature Review

2.1 Overview of the construction industry

The construction industry contributes significantly in terms of employment generation in both developed and developing economies as it provides an entry point into the labour market for the least educated and other disadvantaged sections of the society (ILO, 2001). The industry is, however, characterized by several challenges and difficulties which most often portrays it in a bad light. The poor image of the construction industry is generally thought to stem from the nature of its work, which is often described as 'dirty, difficult and dangerous (ILO, 2001; Kashiwagi and Massner, 2002). A report by Garrity, (1999) reveals that most young people see construction work as dirty and uninteresting, done in harsh weather by not very intelligent people. A survey of high school students in the United States, for example, shows that, out of 250 career options, the choice of construction came 247th as an attractive career option (Kashiwagi and Massner, 2002). Bokinni (2005) also observed that, for many people, the construction industry is seen as the employment of 'the last resort', entered into when an alternative is unavailable or just to continue a family tradition.

2.2 Construction craft skills

The Construction Skills Certification Scheme (CSCS) (2008) classifies construction-related skills into three broad groups as follows: Group A - Craft and Operative, Group B - Technical, Supervisory and Management, and Group C – Construction related Occupations. From the CSCS (2008) classification, the craft operatives' occupational skill is 178; the technical, supervisory, and management occupational group are 63 while construction-related occupation has 436 identified skills. According to Salute to Construction (STC) (2007), occupational skill in construction has two major classifications which are the Craft and Non-craft Careers in Construction. The Crafts Careers in Construction has **15** major crafts which are listed below:

a. Bricklayer
b. Painter and Paperhanger
c. Carpenter
d. Pipe-fitter/Steamfitter
e. Cement Mason
f. Plasterer
g. Electrician
h. Plumber
i. Glazier
j. Operating Engineer/Equipment Operator
k. Roofer
l. Iron Worker

m. Sheet Metal Worker
n. Labourer
o. Surveyor/Field Engineer (Rodman, Chainman, Instrument man, Party chief).

The construction industry's skills areas are vast and diverse, and the various craft skills-persons perform different and specific tasks in the course of any construction project. They also work under different conditions, undergo varied training, and need to meet some general academic and basic physical requirements.

This research however focuses on identifying effective measures of attracting the younger generation (youths) to the core construction skills vocation such as those in the Trowel trades, (i.e. masons, bricklayers), wood trades (carpentry, joinery, furniture making, wood machinist), metal and steel trades (metalwork, steel fixers), plumbing, roofing, tiling and painting and decorating, the site operatives who are directly involved in the actual construction work on the site.

III. METHODOLOGY

The study is carried out in three South-East States of Nigeria, Anambra, Enugu, and Imo using a survey research method.

3.1 *Method of Data collection*

The primary data for this survey was collected using a structured questionnaire, while secondary data was obtained from books, journals, magazines, conference/seminar papers. The questionnaires were used for data collection and were administered to the permanent staff of vocational /technical schools and various building professionals which include: Architect, Builders, Structural Engineers, and Quantity Surveyors in the study area.

3.2 Population and Sample size of the study

The population for this study comprises building professionals and permanent staff of technical/vocational schools in Southeast Nigeria. The selected technical colleges include Government Technical College (G.T.C) Enugu (Enugu State), G.T.C Owerri (Imo State), G.T.C Onitsha and Nigerian Science, and Technical College, NSTC Nnewi (Anambra State). The selected Building professionals comprised Architects, Builders, Structural Engineers, and Quantity Surveyors in the aforementioned States. The rationale behind this is that, by their training, education, and experiences in the construction industry, they are in the best position to provide answers to questions bothering the subject matter. Also to ensure that all information obtained from the structured questionnaires guarantees a reasonable level of validity to achieve the aim of this research work.

The population of the staff and professionals are 366 and 548 respectively (total of 914). Taro Yamane sample size method is employed to determine the appropriate sample size for the study. Taro's formula is represented as:

$$n = \frac{N}{1+N(e)^2}$$

When n = sample size
N = population
e^2 = Margin of error (assumed 5%)
1 = unity or constant
Therefore,
$n = 914 / (1 + 914(0.05)^2)$
n = 914/3.285

n = 278
Consequently, a total of 300 questionnaires were distributed

3.3 *Questionnaire administration*

Data were collected through a structured questionnaire administered to selected respondents. Accordingly, out of a total of 300 questionnaires administered, only 210 were returned, correctly completed, and found useful.

3.4 *Method of analysis and Data presentation*

In the analysis of data, Table; Mean; Percentage; Bar and Pie chart is used to express the statistical results. Suitable statistical tools were adopted for the analysis. The Statistical
Package for Social Sciences (SPSS) software was used to analyse the data using descriptive statistics.
However, Relative Important Index (RII) was used to assess the results, and is computed using the formula:

$$RII = \frac{\sum_{i=1}^{5} W_i X_i}{5 \sum X_i}$$

Where
W_i = the weighting given to each variable by the respondents, ranging from 1- 5
X_i = the percentage of respondents scoring
i = the order number of respondents

IV. DATA PRESENTATION

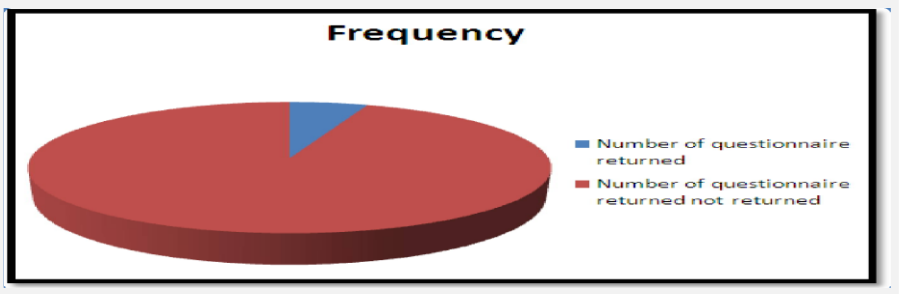
Table 1 presents the percentage responses of the survey. From the table, it can be seen that a total of three hundred questionnaires were administered to various respondents within the study area with only two hundred and ten adequately filled and returned giving a percentage response of 70/0%.

Table 1: *Questionnaire Distribution of the Respondents*

Questionnaire	Frequency	Percentage
Number of questionnaires not returned	40	16
Number of questionnaires returned	210	84
Total	250	100

Source: Researcher's Field Survey, (2020)

Figure 1: Pie Chart Showing Distribution of Questionnaire



Source: Researcher's Field Survey 2020

4.1 Respondents Profile

The breakdowns of the major component of the respondents' profile are presented in this session in Figure 2 — Figure 5 in the form of charts with their corresponding interpretation.

4.1.1 Respondents Professions

Figure 2 shows the bar chart distribution of respondents by nature of their professions in that 3.33% of the respondents were Architects, 23.81% were Builders, 20.95 % of the respondents are Civil/Structural Engineers, Quantity Surveyors (6.19%). while 40.48% were Vocational/Technical Educators and others (5.24%).

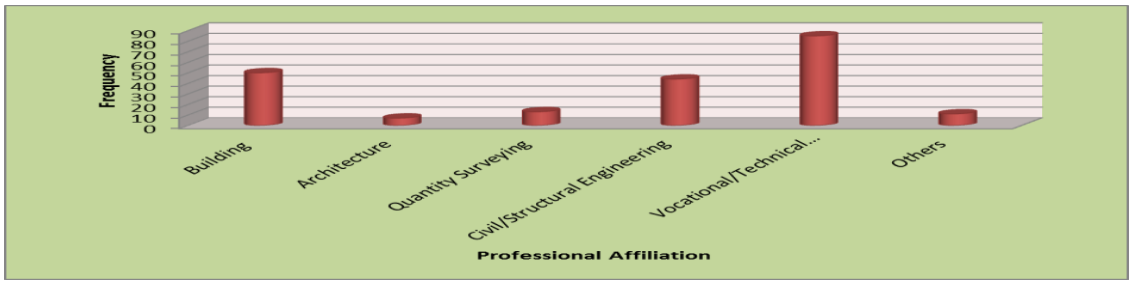


Figure 2. Bar chart of Professional Affiliation of the Respondents
Source: Field Survey 2020

4.1.2 Professional Practice Area

From Figure 3, the bar chart distribution indicates the professional practice areas of most of the respondents are training/education and project management (56.67% and 20.48% respectively), while 9.52% are into consultancy, 11.90% are into contracting services, while only a few (1.43%) are engaged in other professional practice areas.

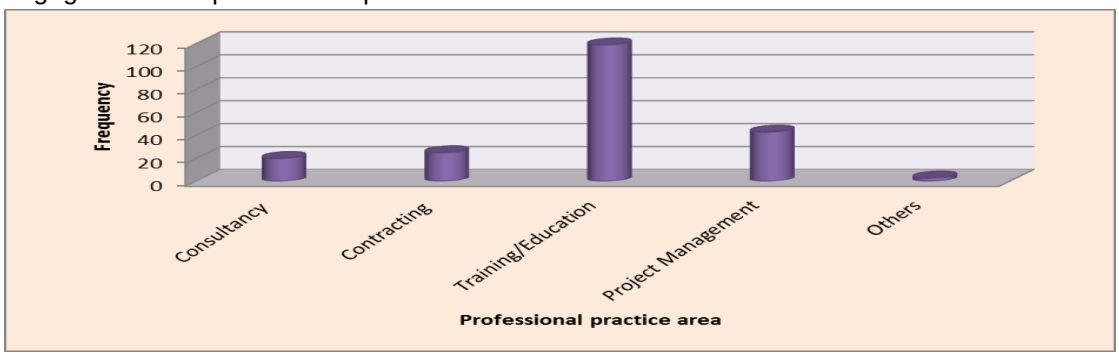


Figure 3. Bar chart of Professional Practice Area of the Respondents
Source: Researcher's Field survey 2020.

4.1.3 Years of Experience of the Respondents

The bar chart distribution in Figure 4 indicates that about 68.57% have been in the system for 10years or more; only 31.43% have less than 10years of experience. It is therefore implied that the respondents have enough experience in the field and can thus, provide adequate and reliable information needed for the study.

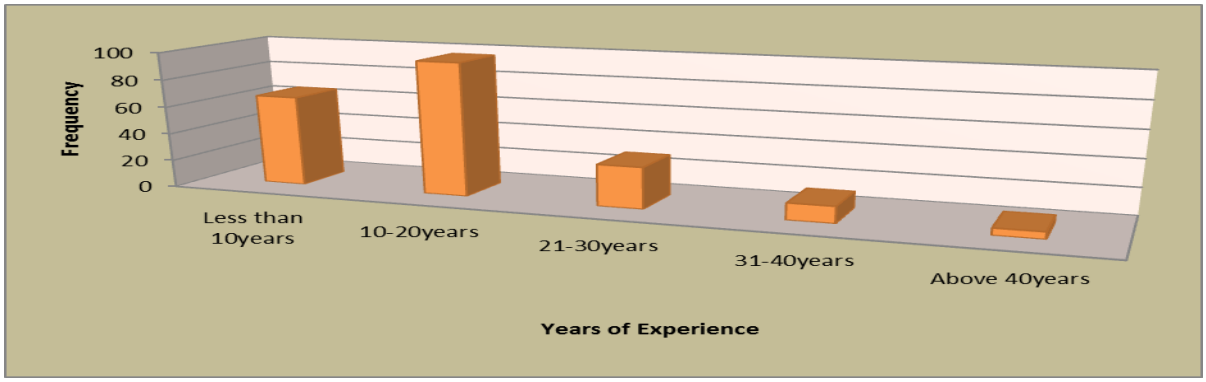


Figure 4. Bar chart of years of Experience of the Respondents
Source: Researcher's Field Survey 2020

4.1.4 Educational attainment/Professional Qualification of the Respondents

From Figure 5, the bar chart distribution indicates that most of the respondents are B.Sc. holders (33.33%) followed by Postgraduate Diploma (PGD) holders (24.76%), M.Sc. holders (20.00%), and HND holders (11.43%). Some (2.86% respectively) are OND and Ph.D. holders, while the rest are scattered around NCE holders (2.38%), WAEC/Technical/NABTEB holders (0.95%), Trade test holders (0.48%), Technical school certificate holders (0.48%), and those who have other professional certificates (0.48%). It is however confirmed that the respondents have adequate and required academic background to provide necessary information for this study

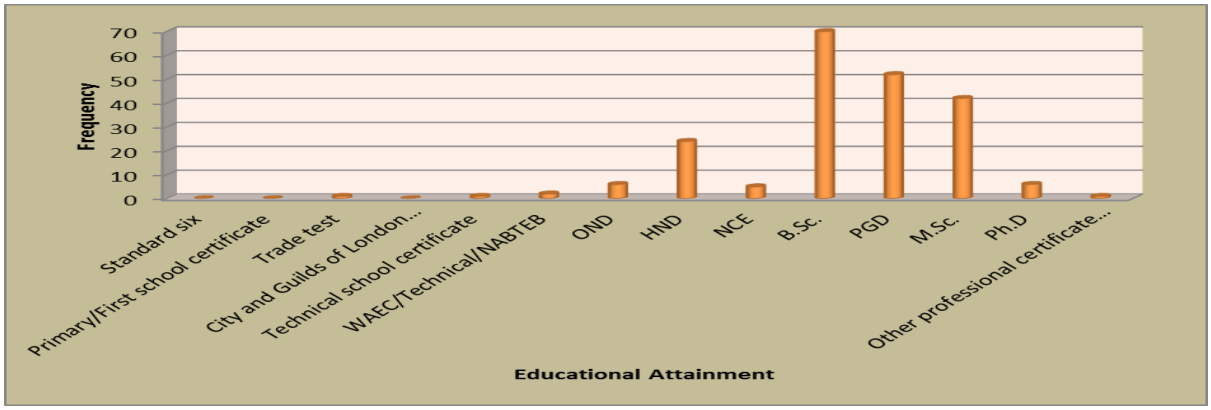


Figure. 5 Bar chart of Educational Attainment of the Respondents
Source: Researcher's field survey 2020

Measures of attracting the Nigerian youth to take up Construction skill

The respondent's ranking of the possible measures that can be used to attract the youth within the study is to take up construction skills and vocation are as presented in Table 3. From the table, it can be deduced that the respondents ranked 'making craftsmen wages attractive' (mean-4.63) as the most viable measure. This was closely followed by other measures such as 'Make skills and vocational training free (mean-4.57); 'properly fund technical/vocational education (mean-4.39), ranked second and third respectively. Close attention to the mean value of all the measures identified shows that the value is closer to 4.0 an indication that the respondent Agrees (4.0) with the viability of the measures as a remedy.

Table 3. Possible measures to attract Nigerian youths to take up construction skill vocation

S/N	Possible ways to attract youths to take up construction skill vocation	Frequency of response					N	Mean	Standard Deviation	Rank
		5	4	3	2	1				
1	Make skills and vocational training free	141	58	2	7	2	210	4.57	0.763	2nd
2	Make craftsmen's wages attractive.	144	59	3	4	0	210	4.63	0.614	1st
3	Make skills trainees earn while they learn	99	90	9	8	4	210	4.30	0.869	5th
4	Accord recognition to skills/vocational education.	93	93	10	8	6	210	4.23	0.922	6th
5	Make skills instruction mandatory at junior secondary	93	68	13	30	6	210	4.01	1.157	8th
6	Make skills instruction mandatory at senior secondary	97	74	15	20	4	210	4.14	1.035	7th
7	Properly fund technical/vocational education.	123	65	7	10	5	210	4.39	0.938	3rd
8	Make career guidance and counselling mandatory at junior secondary level	107	71	7	12	3	210	4.34	0.915	4th
	Cluster Result							**4.33**	**0.902**	

Note SA - Strongly Agreed (5), A-Agreed (4), UD- Undecisive (3), D-Disagreed (2), and SD-Strongly Disagreed (1).

Source: Researcher's Field Survey 2020

From the overall estimate (with cluster mean of 4.33>3.00 and standard deviation of 0.902<1.581), the factors listed in Table 3 are eight possible measures to attract youths to take up construction skill vocation in the area. It can be deduced that the key measure is to make craftsmen's wages attractive (mean=4.63, std. dev. = 0.614). Alternatively, skills and vocational training should be made free in the area (mean = 4.57, std. dev. = 0.763). However, making skills instruction mandatory at junior secondary should be the least option (mean = 4.01, std. dev. = 1.157).

V. CONCLUSION AND RECOMMENDATION

The effectiveness of the construction industry no doubt depends on the skills and condition of the workforce. In other to achieve sustainable construction activities, youths need to be attracted to construction vocations. This can be achieved through improved and attractive wages of craftsmen which were found to be the most effective and key strategy to attract the younger generation taking up a career path in the construction industry. Also, making skills acquisition and vocational training free is another beneficial and pragmatic measure that could be adopted after wages improvement. However, making skills instruction mandatory at junior secondary was considered the least and insignificant in this regard. Therefore the study recommends:

i. Improved wages for construction skilled labors (craftsmen and artisans) to commensurate the efforts in doing the work
ii. Make skills acquisition and vocational training free to make it accessible to any class of individual- the poor and the rich alike.
iii. Reorientation of the youths on the need for acquisition of construction skills,
iv. Proper funding and rehabilitation of technical/vocational colleges, making them highly equipped, appealing, efficient, and effective in the production of competent skills.

Furthermore, as part of the measures to encourage construction skill acquisition, the local government councils, professional bodies, senior secondary schools, and junior secondary school teachers are required to take an active role by creating awareness among the youths, and avenues for construction skills acquisition and training for them. This done, will ensure a sustainable supply of crafts skilled workmen for an effective building delivery process in the construction industry.

REFERENCES

[1.] Abdullahi, U., Anum, I., Adole, A. M. & Williams, F. N. (2015).Artisans Working Condition in the Nigerian Construction Industry: A Case Study of Some States In Northern Nigeria. *ATBU Journal of Environmental Technology,* ***8***(1), 16-25.

[2.] Agbola, S.B. (2005): The Housing Debacle. Inaugural Lecture, Dept of Urban and Regional Planning, University of Ibadan, Ibadan.

[3.] Bilau, A. A., Ajagbe, M. A., Kibu, H. H. and Sholanke, A. B. (2015). Review of Shortage of Skilled Craftsmen in Small and Medium Construction Firms in Nigeria. Journal of Environment and Earth Science, 5(15), 98-110.

[4.] Bokinni, S.K. (2005) Skill Acquisition and Development for Craftsmen and Artisans. The Professional Builder, Journal of the Nigerian Institute of Building. Pp. 100-111.

[5.] Darren, O; Mark, T. and Christopher, D. (2012). How Industrial Contractors are Handling Skilled Labour Shortages in the United States. Proceedings of the 48th Associated Schools of Construction (ASC) Annual International Conference

[6.] Fagbenle O.I (2004). Factor Affecting the Performance of Labour in Nigeria Construction Sites.

[7.] International Labour Organisation (ILO) (2001). The Construction industry in the Twenty-First Century: Its image, Employment Prospects, and Skill Requirement. Tripartite Meeting on the Construction industry, ILO Geneva, 10-14th December 2001.

[8.] Medugu, N. I., Rafee, M., Bustani, S. A., Bala, K., Abdullahi, U., & Mbamali, I. (2011). Craft Skills Availability in the Nigerian Construction Industry: Perception of Contractors and Consultants. The IUP Journal of Infrastructure, 9(3), 63-73.

[9.] Onibokun, A. G. (2002). Making Housing affordable to low-income families. Seminar paper presented at Centre for Urban and Regional Planning, University of Ibadan.

[10.] Oyegoke, A. S., McDermott, P., Aouad, G. & Cleary, M. (2009). Skill competency development strategies by a contractor. Proceedings of the Institution of Civil Engineers. Management, Procurement and Law 162, 1-10.

[11.] Rafee M.M. (2012). Craft Skills availability in the Nigerian Construction Industry. Journal of the Nigerian Association of Engineering Craftsmen, 7, 8-12.

[12.] Salute to Construction (STC) (2007). Crafts careers in construction. Available at: <http://www.salutetoconstruction.org/craft.php>.

International Journal of Innovation Engineering and Science Research
(ISSN: 2581-4591)
www.ijiesr.com

Isolation and Identification of Antioxidant Compound of Isolate Algae *Kappaphycus Alvarezii* from Madura Waters

Vonda Milca N Lalopua.
Study Program of Fisheries Technology, Faculty of Fisheries and Marine Science
Pattimura Unversity
Jl. Chr. Soplanit Poka Ambon 92333

ABSTRACT

The objective of the study is to identify antioxidant compounds from the isolates of the ethyl acetate extract of *K. alvarezii* from Madura Ocean. Isolation and purification of *K. alvarezii* algae were carried out in four stages, by using column chromatography and thin layer chromatography. The passive phase of column chromatography is the silica gel, while the active phase is a solvent mixture of hexane-ethyl acetate-methanol, with 10% gradient (isolation Phase 1). The isolation phase two is a mixture of chloroform-methanol with 5% gradient, the active phase for isolation of stage three is a mixture of methanol-water solvent with 6% gradient and a solvent mixture of chloroform-methanol 2.5% is the isolation of the fourth stage for active phase. The results of the isolation of the fourth stage were detected by thin layer chromatography and $FeCl_3$ and H_2SO_4 spray reagents with heating for stain detection that appeared on the TLC plate. The fourth phase of the isolate was identified by UV-Vis spectrophotometer and FTIR spectrophotometer. UV spectrum data shows the presence of aromatic compounds while the infrared spectrum data shows the peak at wave number 1700 cm^{-1}, which is the carbonyl function cluster C = O, at wave number 3500 cm^{-1} shows an OH function cluster, and at wave number 3000 cm^{-1} or 1050 cm^{-1} shows an aromatic function cluster. The function cluster of C = O is a function cluster of carboxylic and amide, and the function cluster of OH and aromatic.

Keywords: UV spectrum, IR spectrum,* K. alvarezii, *Madura Waters

I. INTRODUCTION

K. alvarezii algae grow attached to the substrate at the bottom of the water in the form of dead coral on live corals with disc-shaped adhesive. In general, *K. alvarezii* algae found in intertidal areas or in areas which are always submerged by water (subtidal). The algae grows well in coastal areas that consist reefs, because in these areas some requirements for algae growth are fulfilled, such as water depth factor, light, substrate and water movement. The light intensity temperature and nutrients are important factors which influence the growth of *K.alvarezii* algae (Glenn dan Doty, 1990). Ohno, *et al.* (1994) report that *K. alvarezii* algae grows merely during summer at 20^o – 30^o C in the subtropical waters of Tosa Bay, Japan.

According to Karsten and Wiencke (1999), algae which grow in tropical climates have relatively high antioxidant activity which indicated by the connection between ultraviolet light absorption and the metabolic level of an antioxidant compound. The absorption level of algae to ultraviolet light influenced by the depth and turbidity of the waters, geographic location (Karsten dan Wiencke, 1999), time waktu (Aquilera *et al*. 2002), and ocean topography (Yuan dan Walsh, 2005). *K. alvarezii* has been examined and proven to contain antioxidant compounds, such as primary metabolites

compound that comprises polysaccharides that have low molecular weight, peptides, pigments, ascorbic acid, vitamin A and phenolics (Kumar *et al*. 2008 dan Sriwardhana *et al*. 2003).

Natural antioxidant compounds that contained in plant tissues are soluble in water or fat and in the form of being bound to walls of the plant cell. Antioxidant compounds need to be detached from plant tissue using the appropriate extraction method in accordance with the solubility of the compound. Antioxidant compounds that had been extracted by solvents are still mixed with interfering compounds so that they need to be isolated and purified by a proper isolation method. Antioxidant compounds purification is required in order to determine the chemical structure, which is the identity of the compound based on its physicochemical characteristic. Algae antioxidant compounds are various, depending on species, harvest time and growth conditions, light, climate, and post-harvest conditions (Kuda *et al*. 2005). Information regarding the antioxidant compound of *K. alvarezii* that grows in Indonesia, especially from the results of secondary metabolites, is still inadequate and has not been widely studied. Thus, The study aims to identify antioxidant compounds of an isolate of *K. alvarezii* algae from Madura waters.

II. MATERIALS AND METHOD

MATERIALS

The materials used in this research were ethyl acetate extract of *K. alvarezii* algae. Methanol, n-hexane, ethyl acetate, chloroform, aquades and acetone in pro analysis (PA) category, silica gel G60 plate size 20 cm x 20 cm, viewer reagent $FeCl_3$ and H_2SO_4 were used for insulation and identification of antioxidant compounds. Other materials are aluminum foil and plastic cling wrap sheets for sample preparation.

TOOLS

The used equipment consisted of chromatographic columns (height 40 cm diameter 3 cm), 10 ml vial bottles, drop pipettes, KLT plates size 20 cm x 20 cm, UV-Vis spectrophotometers (Shimadzu brand, 1601), FTIR spectrophotometers (multi spec), LCMS (Waters type LCT Premier XE brand), NMR (JEOL JNM ECA-500 brand).

RESEARCH METHOD

± 3 kg Algae powder from Madura was taken and put in a sealed container (plastic jerrycan). The methanol added to algae powder by a ratio of 1 part powder and 3 parts solvent (b/v). The mixture of algae powder and solvent was stirred for a while and left to be submerged in methanol for maceration which lasted for 3 days. The method by Faten *et al.* (2009) was used for the extraction and fractionation.

Isolation and Purification of the Best *K. alvarezii* Coarse Extract

Isolation and purification of *K. alvarezii* algae coarse extract were carried out on coarse extract of ethyl acetate *K. alvarezii* from Madura from the results of vacuum oven drying at 40^o C. Ethyl acetate fraction was isolated and purified in four stages of isolation by column chromatography, followed by thin layer chromatography. The size of the chromatographic column that used is 40 cm lenght and 3 cm in diameter. Whereas the type of thin layer chromatography that used is G**60,** size 20 cm x 20 cm. The passive phase for column chromatography is silica gel and the active phase for isolation of stage I is a solvent mixture of hexane-ethyl acetate-methanol, with a 10% gradient. While the active phase for isolation of stage two is the solvent mixture of chloroform-methanol with a 5% gradient, and for the active phase for the isolation of stage three is a mixture of methanol-water solvent with a 6% gradient, and the active phase for isolation of stage four is a mixture of chloroform-methanol 2,5%.The isolation fraction was detected by thin layer chromatography, and the $FeCl_3$ and H_2SO_4 spray reagents were used accompanied by heating for stain detection that appeared on the KLT plate, while quercetin was used as the standard.

III. RESULTS AND DISCUSSION

1. UV-Vs Spectrum of Antioxidant Compound Isolate *K. alvarezii* of Madura

Results of UV-Vis spectra, *Kappaphycus alvarezii* isolate of Madura are presented in Figure 1.

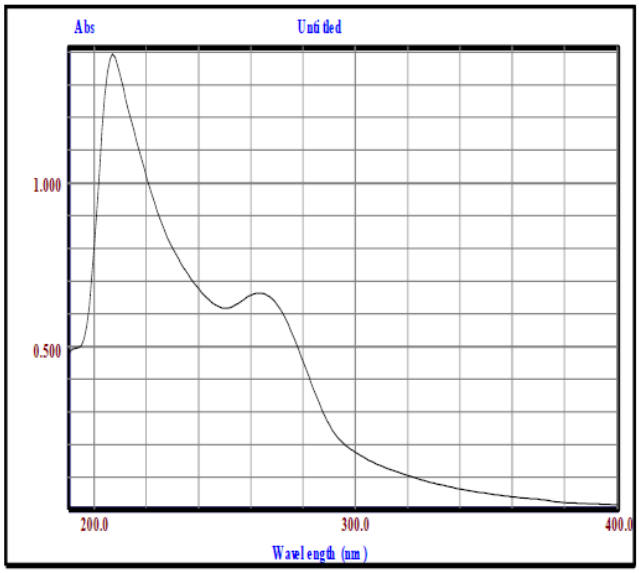
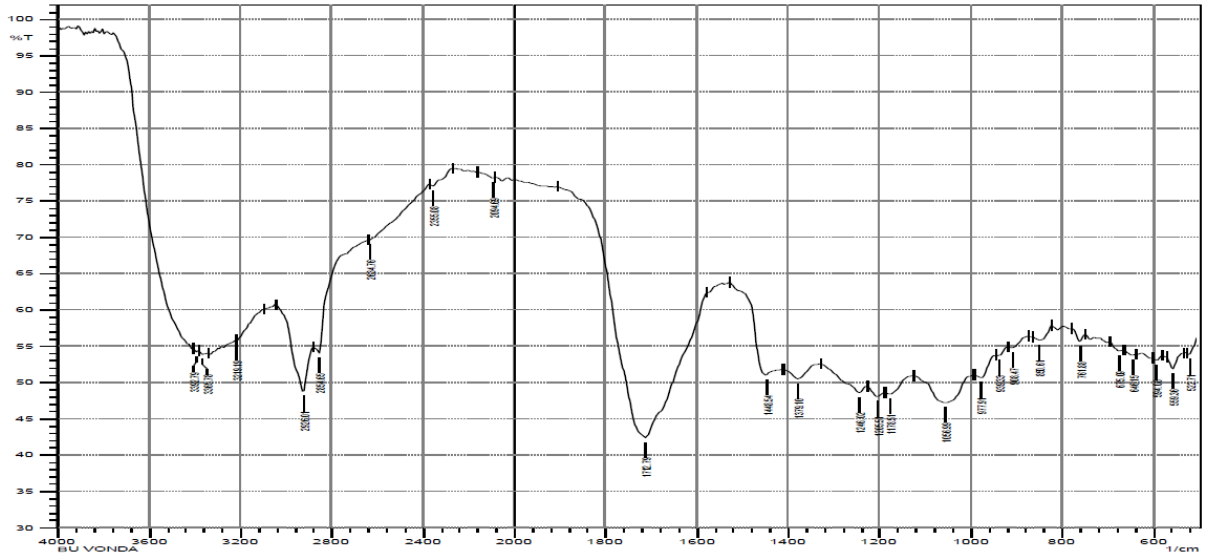


Figure 1. UV-Vis spectrum, antioxidant compound isolate of *K.alvarezii* from Madura

Figure 1 shows 2 maximum absorption peaks, in which the first absorption peak at a wavelength of 207 nm and the second absorption peak at a wavelength of 263 nm. The maximum absorption of an identified compound is evidence that the compound has a conjugated double bond. A conjugated double bond is an unsaturated cluster which go through electronic transition from orbitals n - n* and – ∗. The conjugated double bond is possessed by compounds with chromophore or auxochrome structures. The compound with a chromophore structure has function clusters such as -C=C-, -C$^{=}$C-, -NO_2 or -C-, while the auxochrome structure has function clusters, namely -OH, -OR, -NH_2, -NHR, or -NR_2. The absorption of organic compounds at wavelengths above 200 nm is the area of electron excitation absorption in orbital π and orbital of bond systems π conjugated, including a conjugation expansion of the double bond system (silent electrons from oxygen, nitrogen and sulfur molecules). Based on absorption data for the chromophore structure, then the absorption at wavelength 207 shows absorption the amide function cluster ($RCONH_2$) which absorbs maximum at wavelength < 208 nm with transition n -- n*. The shifting towards a larger wavelength (batochromic shifting) is suspected because of the conjugation extension of the compound structure due to the effect of solvents, shifting reagents or the presence of auxochrome structures, so that the transition energy will be smaller and the wavelength will be larger (Supratman, 2010).

2. The Infrared Spectrum of the *K. alvarezii* Antioxidant Compound Isolate from Madura

The infrared spectrum of a molecule is the result of a transition between different energy levels (vibration) of an electron, therefore the infrared spectrum can be used to identify the function cluster of a molecule. The absorption of the function cluster of *K. alvarezii* isolate compound from Madura is presented in Figure 2.



Wavenumber (cm)

Figure 2. Infrared spectrum of *K. alvarezii* isolate from Madura

Based on the correlation map for the determination of function cluster, the absorption of function cluster of *K. alvarezii* isolate compound in Figure 2 can be categorized, according to the function cluster, as follows:

- Spectrum in the wave area of 800 - 900 cm^{-1} (850.61 cm^{-1}; 908.47 cm^{-1}; 939, 33 cm^{-1} and 977.91 cm^{-1}) shows the function cluster of C-H, aromatic.
- Spectrum in the wave area of 900 - 1300 cm^{-1} (977,91 cm^{-1} ; 1038, 99 cm^{-1}; 1178, 61 cm^{-1} ; 1205, 51 cm^{-1} dan 1246, 02 cm^{-1}) shows the function cluster of C-C, C-N and C-O, stretching.
- Spectrum in the wave area of 1250-1400 cm^{-1} (1205,51 cm^{-1}; 1246,02 cm^{-1}; 1379,1 cm^{-1} and 1448,54 cm^{-1}) shows the function cluster of O-H.
- Spectrum in the wave area of 1200 -1500 (1448 cm^{-1},1379,10 cm^{-1};1246,02 cm^{-1} dan 1205, 51 cm^{-1}) shows the function cluster of OH and CH, bending.
- Spectrum in the wave area of 1600 – 1800 cm^{-1} (1729, 79 cm^{-1})) shows the function cluster of C=O, stretching (cluster of aryl / ketone / carboxylic and amide).
- Spectrum in the wave area of 2500 – 3000 cm^{-1} (2926 cm^{-1} dan 2861,135 cm^{-1}) shows the function cluster of C-H, stretching.
- Spectrum in the wave area of 3000 - 3500 cm^{-1} (382, 79 cm^{-1} dan 3385,78 cm^{-1}) shows the absorption of function cluster O-H and N-H, stretching.

The figure 2 shows that absorption in the area between 3000 - 3500 cm^{-1} is the absorption of bound O-H cluster (hydrogen bond), because the bound O-H cluster provides absorption with lower and wider frequencies. Figure 2. also shows that in the wave area of 1448 - 1205 cm^{-1}, presumably, there is a shifting frequency due to the effects of induction, mesomeric and field effects that cause changing on bond strength and frequency. The shifting of frequency that occurs on absorption in the wave area of 1448 - 1205 cm^{-1}, allegedly due to additional alkyl cluster on carbonyl compounds so that the extension of the conjugation has occurred (hyperconjugation effect) and causes the C=O bond weakened and consequently, the strength of bond and frequency decrease. Presence of the

conjugation (unsaturated carbonyl group or aromatic ring) also causes the decrease of absorption frequency of vibration stretching C=O and C=C.

IV. CONCLUSIONS

Spectrum data of isolate *K. alvarezii* shows the existence of aromatic cpmpounds and the infrared spectrum data which shows the peak at wavenumber 1700 cm^{-1} is a carbonyl of function cluster C=O, wavenumber 3500 cm^{-1} shows function cluster of OH, and wavenumber 3000 cm^{-1} or 1050 cm^{-1} shows the aromatic function cluster. The function cluster of C=O is a carboxylic and amide, as well as the function cluster of OH and aromatic.

REFERENCES

[1.] Aguilera, J., Bischof, K., Karsten, U., and Hanelt, D. 2002. "Seasonal Variation in Ecophysiological Paterns in Macroalgae from an Artic fjord II. Pigmentation Accumulation and Biochemical Defense System Against High Light Stress" in *Marine Biol* 140: 1087 – 1095.

[2.] Faten, I.M., Abou-Elala,M., and Emad, A.S. 2009. "Antioxidant Activity of Extract Sei adn Purified Fraction of Marine Red Macro Algae, *Gracillaria verrucossa*", in *Australian Journal of Basic and Applied Sciences* (4): 3179 – 3185.

[3.] Glenn, E.P.and Doty,M.S., 1990. "Growth of the Seaweeds *Kappaphycus alvarezii, K. Striatum* and *Euchema Denticulatum* as Affected by Enviroment in Hawaii", in *Aquaculture* 84:245 – 255

[4.] Karsten, U. and Wiencke, C. 1999. "Factors Controlling the Formation of UV Absorbing Mycosporine Like Amino Acids in the Marine Red Algae *Palmaria Palmata* from Spitsbergen (Norway)", in *Journal of Plant Physiology* 155:407 – 415.

[5.] Kumar, K., Suresh, K., Ganesan, P.V. and Rao, S. 2008. "Antioxidant Potential of Solvents Extract of *Kappahycus alvarezii* (Doty) Doty an Edible Seaweed", in *Food Chemistry* 107:289 – 295.

[6.] Ohno, M., Largo, D.B., and Ikumoto, T. 1994. "Growth Rate, Carrageenan Yield and Gel Properties of Cultured *Kappacarrageenan* Producing Red Algae *Kappaphycus alvarezii* (Doty) Doty in the Subtropical Waters of Shikoku,Japan", in *J. Appl. Phycol* 6:1 – 5.

[7.] Sriwardhana, N., Lee, K.W., Kim, S.H., Ha, J.W., and Jeon, J.Y. 2003. "Antioxidant Activity of *Hizikia fusiformis* on Reactive Oxygen Species Scavenging and Lipid Peroxidation Inhibition", in *J. Food Science and Technology International* 9: 339 – 347.

[8.] Supratman, U. 2010. *Elusidasi Struktur Senyawa Organik Metode Spektroskopi untuk Penentuan Struktur Senyawa Organik*. Penerbit Widya Padjajaran.

International Journal of Innovation Engineering and Science Research
(ISSN: 2581-4591)
www.ijiesr.com

Cost Performance Analysis of the Drainage and Sidewalk Rehabilitation Project of Jalan Teuku Umar Package Iwith Earned Value Method

Sugiyanto & Akhmat Kosbiamtoro
Civil Engineering Study Program, Faculty of Engineering,
SunanBonang University, Tuban Indonesia

ABSTRACT

In the implementation of construction projects requires a good management so that the project can achieve a planned goal. The accuracy of cost, time and quality is very influential on the success of a project. One of the project targets that needs to be considered is the cost factor. The object of this research was the Drainage and Sidewalk Rehabilitation project of JalanTeuku Umar Package I located in Tuban District, Tuban Regency, East Java Province, Indonesia. This study aims to determine the value of variables, indicators and index value results, namely BCWS, BCWP, ACWP, CV, SV, and CPI; thereby generating an estimate of the profit or loss on the ongoing project. Observations for data collection consisted of the 1st week period to the 13th week period with a total work duration of 13 periods. From the results of the analysis using the earned value method from the 1st period to the 13th period, the CV value was not found to be negative. This indicates that during the course of the project from each observation, the actual costs are always lower than the budget costs. Then the SV value has a negative value between the 4th and 12th periods, this informs that during the period the project is running, the progress process is slower than planned even though in the last week the project can be completed according to the deadline. For the CPI value, no value <1 is found. Thus, it can be seen that the estimated final cost of the EAC project (estimate at complete) is the total cost of Rp. 1,367,150,467.79 of the planned budget of Rp. 1,444,139,145,55 with a profit of Rp. 76,988,677,76 so that it can be stated that the work is completed with a 5.3% more cost-effective (cost underrun).

Keywords: Project, performance, cost, and result value analysis.

I. INTRODUCTION

The development of a construction project that is getting bigger and more complicated today, both in terms of cost and physical form. In practice a construction project has limited resources, either in the form of labor, equipment, methods, materials or costs. With these limitations, a project management is needed from the initial phase to the project completion phase. Planning, cost and time control is the scope of the overall construction project management. Apart from the quality aspect, achievement in a project can also be assessed in terms of cost. The costs used in completing a job must be measured carefully, especially if there is a deviation from a plan. The existence of significant cost deviations is a symptom of poor project management. The existence of performance indicators in terms of costs can allow preventive actions so that a project is carried out according to plan.

In construction management; planning, implementation and control of construction services can be arranged in accordance with existing resources. Therefore, it is required to be able to compete and be able to carry out projects on time, on budget and smoothly according to job specifications. Construction projects have unique characteristics or are not repetitive, require resources, and are in an organizational setting to realize project goals and objectives. Projects that occur in a particular project will not be repeated onother projects. This is because the conditions that affect the process of

a construction project differ from one another. Natural conditions such as geographical location, rainfall, earthquakes and soil conditions, are factors that also affect the uniqueness of a construction project.

Making a work plan is one of the first steps of planning. Planning is made to achieve high effectiveness and efficiency of the resources that will be used during the implementation of the construction project. The planned resources include labor, equipment/machine, materials, and money. These resources must be planned as efficiently and effectively as possible in order to obtain implementation costs that are within the budget (saving budget), meet quality targets and planned deadlines. This is because in the implementation of a project it is sometimes rare to find a project that goes exactly as planned. Generally experiencing delays than planned, both time and progress of work if in project implementation there is no good control effort. On the other hand, there are also projects that have accelerated from the initial planned schedule and even budget costs can be achieved more efficiently than planned because there are effective control efforts because every deviation from the plan there is room for the deviation to be corrected immediately.

Reksohadiprojo (1983) states that project management is an effort to plan, organize, direct, coordinate and supervise activities in the project in such a way that it is in accordance with the time schedule and budget that has been set. Similarly, Pastiarsa (2015) states that the objective of project management is to manage a project in such a way that a result (derivables) is obtained that meets the technical scope and requirements according to the budget and time limits that have been determined and at the level of risk, quality, safety and security that is acceptable tolerable. Furthermore, Handoko (1999) explains in more detail that the objectives of project management are as follows:

1. Right on budget, namely costs that must be spent in accordance with a predetermined budget
2. On time, namely the time or schedule which is one of the main targets of the project, delays will result in losses, such as additional costs, lost product opportunities to enter the market.
3. Exact specifications, where the project must be in accordance with the quality specifications that have been set.

In the implementation of a project may experience delays, acceleration, or on time according to the project plan schedule. In terms of costs, the implementation of a project may experience advantages or disadvantages. In the concept of the value of the results (earned value) can be used to predict whether the project completion is in accordance with the initial plan of the project schedule in each reporting period and the amount of profit or loss at the end of the project. Husen (2011) stated that the project evaluation to control time and cost is the result value method. In the application of this method is the application of the use of the S curve for control in the implementation of a project. The shape of the S curve is a yield value curve to evaluate the use of project costs and time schedules at once and is more realistic than the conditions that occur in the field. The S curve will describe the progress of the volume of work carried out throughout the project cycle. The S curve is very useful for use as monthly reports and reports to project leaders, because this curve can clearly show the progress of the project in an easy-to-understand form.

The concept of yield value is a project management method used to control costs and time. This method provides information about cost variance, schedule variance, cost performance index, and project schedule performance index in the reporting period. This method also obtains information on the prediction of the amount of costs and the length of time for the completion of all work based on performance indicators at the time of reporting. The earned value concept presents three dimensions, namely the actual costs that have been incurred which are called actual costs, the physical completion of the project that reflects the planned cost absorption and what has been spent or what is called earned value. Thus, there are 3 (three) variables that become references in analyzing projects based on earned value cost (EVC), namely:

1. Budgeted cost for work scheduled (BCWS)

   BCWS is a budget that is allocated based on a work plan that has been prepared according to

time. BCWS is calculated from the accumulated budget for the work planned for a certain period of time. BCWS is also a benchmark for the time performance of project implementation. BCWS reflects the cumulative absorption of plan costs for each work package based on the sequence according to the planned schedule.

2. Actual cost for work performed (ACWP)
   ACWP is a representation of the overall expenses incurred to complete the work in a certain period. ACWP can be cumulative up to a performance calculation period or the amount of expenses incurred in a certain period of time.
3. Budgeted cost for work performed (BCWP)
   BCWP is the value received from the completion of work over a certain period of time. This BCWP is called earned value. This BCWP is calculated based on the accumulation of completed works. By using the yield value concept method, it can be developed to make estimates or projections of the future state of the project which is very useful input for managers and owners, because then they have enough time to think about ways to deal with all problems in the future come. For example to project whether the remaining funds are sufficient to complete the project.

Regarding the development activities carried out by the Tuban Regency government with the 2021 APBD budget sources, one of which is the drainage and pavement rehabilitation work on JalanTeuku Umar Package I which is an important project to overcome drainage problems, especially when it rains. With the construction of an object that is classified as very vital and requires a large budget, it is necessary to plan work from the initial stage of the activity to completion using the result value method so that the cost performance in implementing the project can be known. Therefore, a research entitled "Analysis of Cost Performance in the Implementation of Drainage and Sidewalk Rehabilitation Works on JalanTeuku Umar Package I with the Result Value Method" is very necessary.

II. RESEARCH METHODS

To facilitate the analysis and processing of data, in the implementation of this research the observation process is carried out in a weekly period (data per week). The project implementation time starts from July 16, 2021 until the deadline for project completion on October 14, 2021, then 13 weeks of observation/reporting data will be obtained consisting of the period:

1. 1st week = July 16 to July 21, 2021 (Duration of 6 days)
2. 2nd week = July 22 to July 28, 2021 (Duration of 7 days)
3. 3rd week = July 29 to August 04, 2021 (Duration of 7 days)
4. 4th week = August 05 to August 11, 2021 (Duration of 7 days)
5. 5th week = August 12 to August 18, 2021 (Duration of 7 days)
6. 6thweek= August 19 to August 25, 2021 (Duration of 7 days)
7. 7th week = August 26 to September 01, 2021 (Duration of 7 days)
8. 8th week = September 02 to September 08, 2021 (Duration of 7 days)
9. 9th week = September 09 to September 15, 2021 (Duration 7 days)
10. 10th week = September 16 to September 22, 2021 (Duration of 7 days)
11. 11th week = September 23 to September 29, 2021 (Duration of 7 days)
12. 12th week = September 30 to October 06, 2021 (Duration 7 days)
13. 13th = October 07 to October 14, 2021 (Duration of 7 days)

Total project observation schedule = 13 weeks (Total project duration 90 working days)

The method of data collection in the implementation of this research can be explained as follows:

1. Primary Data, consisting of:
   a. Project Expenses
      This data represents the actual cost of implementing the project in the application of the yield value method, which is obtained from parties who have the authority to record/administrate project expenditures (accounting department). To facilitate data processing, in the implementation of this study, the calculation of project expenditure costs was recorded from the

project running to completion and was recapitulated every day, compiled and recapitulated according to a predetermined weekly period, then accumulated into the total cost of project expenditure.

b. Project Runtime

This data is obtained directly from the running time of the project, by monitoring the actual condition of completion of each project period with the need for analysis using the yield value method, calculating the time required for completion of each period. Recording is carried out starting from the beginning of project implementation until the time the project is declared complete and well received by the project owner.

2. Secondary Data, consisting of:

Secondary data, namely data that is already available from other parties, so we must try to get the data as needed. Secondary data in this study are:

a. Project Time Scheduling Data

The project time schedule contains descriptions of activities/activities along with the time requirements and when the project must be completed.

b. Project Budget Plan

Consists of a list of cost recapitulation, volume and unit price of work, priceunit wages, quantity and unit price of materials, analysis of work unit prices,administration & general, management and other expenses.

c. Work plan and conditions for project implementation

Is a document that contains the name of the project along with an explanation in the form of: type, size and location, as well as procedures for implementation, work requirements,requirements for quality of work and other information that can only bedescribed in writing.

d. Job load

This data is in the form of the work weight of the project implementation plan which is expressed in % of each project activity.

The measurement of variables carried out in the implementation of this research consists of the following:

1. Calculation of Budgeted Cost Of Work Schedule (BCWS) variables

This variable is obtained by calculating the percentage of the work plan multiplied by the total project cost that has been planned based on the following formula:

$$\mathbf{BCWS = \%\,Planning \times BAC}$$

2. Calculation of the variable Budgeted Cost Of Work Performance (BCWP)

This variable is obtained by calculating the percentage of completion/realization multiplied by the total project cost that has been planned based on the following formula:

$$\mathbf{BCWP = \%\ Actual \times BAC}$$

3.Calculation of the Actual Cost Of Performance (ACWP) variable

This variable is obtained by calculating the actual budget (actual costs) used for the activities that have been carried out.

4. Calculation of the Schedule Variance (SV) indicator

This indicator is calculated by subtracting the value of the BCWP variable with the value of the BCWS variable according to the following formula:

$$\mathbf{SV = BCWP - BCWS}$$

5. Calculation of the Cost Variance (CV) indicator

This indicator is calculated by subtracting the value of the BCWP variable with the ACWP variable

value according to the following formula:

$$CV=BCWP – ACWP$$

6. Calculation of Schedule Performance Index (SPI)
   This indicator is calculated by dividing the value of the BCWP variable by the value of the BCWS variable according to the following formula:

$$SPI=BCWP: BCWS$$

7. Calculation of Cost Performance Index (CPI)
   This indicator is calculated by dividing the value of the BCWP variable by the ACWP variable value according to the following formula:

$$CPI=BCWP/ACWP$$

Processing and analyzing data in the implementation of this research is to use the following software:

1. Descriptive quantitative analysis using microsoft excel. This analysis is to calculate and process quantitative data consisting of budget data, value results, details of costs on project implementation, calculation of cost and schedule performance indicators, and calculation of cost and schedule performance indexes.
2. Qualitative descriptive analysis using microsoft word. This analysis is to obtain a graphic visualization of the S curve that describes the progress of the project being researched. The shape of the S curve consists of integrating progress over time to obtain the cumulative progress used in job monitoring. The measure of progress is emphasized on work progress and costs. The X axis shows the time scale (duration of project implementation), while the Y axis represents the cost or work performance scale, which consists of the variables BCWS, ACWP and BCWP.

III. RESULTS AND DISCUSSION

1. Analysis of Project Cost Performance Based on Earned Value Variables

Based on data from data sources (second parties) obtained in the draft budget on the implementation of the drainage and sidewalk rehabilitation project for JalanTeuku Umar packageI, it can be shown in Table 1 below:

Table 1. Draft Budget for Drainage and Sidewalk Rehabilitation of JalanTeuku Umar Package I

Observation Period		Project Cost Budget Draft (BCWS Varaible)	
Week-	Days to-	Budget per week (Rp)	Cumulative budget (Rp)
1	6	81.836.376,82	81.836.376,82
2	13	130.315.645,04	212.152.021,86
3	20	130.315.645,04	342.467.666,91
4	27	68.903.403,76	411.371.070,67
5	34	109.229.107,79	520.600.178,46
6	41	68.903.403,76	589.503.582,21
7	48	68.903.403,76	658.406.985,97
8	55	68.903.403,76	727.310.389,72
9	62	68.903.403,76	796.213.793,48
10	69	130.315.645,04	926.529.438,52
11	76	130.315.645,04	1.056.845.083,57
12	83	191.727.886,33	1.248.572.969,90
13	90	195.566.175,65	1.444.139.145,55

Source: Barokah, CV (2021)

In Table 1, it is shown that the project budget plan is scheduled for a 90 calendar day working period starting from July 16, 2021 until the deadline for project completion on October 14, 2021. Based on the project schedule, to facilitate data analysis and processing, the duration is divided into periods per week so that 13 (thirteen) weeks of observation data are obtained. In each of these week periods, the amount of the budget for each period per week is distributed with the largest activity in the 12th and 13th weeks requiring a budget of Rp. 191,727,886.33 and Rp. 195,566,175,65. The table also presents data on a cumulative project budget value of Rp. 1,444,139,145,55 (#One billion four hundred forty-four million one hundred and thirty-nine thousand one hundred forty-five point fifty five rupiah#). The amount of the budget value, in the sum of all periods/cumulative (duration of 90 days) is called the Budgeted Cost for Work Schedule (BCWS) variable.

Rani (2016) said that management in the implementation of construction is carried out by planning and scheduling, which is a process that tries to lay the basis for goals and objectives, including preparing all resources to achieve project goals and objectives. The purpose of the construction is to complete the work and benefit from the total costs incurred. The targets in the construction implementation are business development and productivity improvement. In connection with the implementation of the research on project cost performance, the actual expenditure on the implementation of the Teuku Umar Road drainage and sidewalk rehabilitation project package I consists of a recapitulation of costs consisting of: labor, materials, general administration and management and others. Based on the results of the recapitulation of the actual project costs on the object under study, it can be presented in Table 2 below:

Table 2. Actual Cost of Drainage and Sidewalk Rehabilitation of JalanTeuku Umar Package I

Observation Period		Actual cost project implementation (ACWP variable)	
Week-	Days to-	Actual cost per week (Rp)	Actual cost cumulative (Rp)
1	6	6.300.162,31	6.300.162,31
2	13	133.569.494,52	139.869.656,83
3	20	179.095.228,07	318.964.884,90
4	27	102.535.435,92	421.500.320,81
5	34	113.472.549,08	534.972.869,89
6	41	71.091.235,57	606.064.105,46
7	48	76.559.792,15	682.623.897,61
8	55	86.129.766,17	768.753.663,78
9	62	66.716.390,30	835.470.054,08
10	69	190.852.624,72	1.026.322.678,80
11	76	130.698.502,31	1.157.021.181,12
12	83	172.259.532,34	1.329.280.713,46
13	90	37.869.754,33	1.367.150.467,79

Source: Barokah, CV (2021)

In Table 2 above, the actual cost of the project is shown according to the recording in the accounting for project implementation, which consists of expenditures per week and in cumulative totals. For activities in the 3rd week and 10th week, they differed sharply from planning and recorded the largest actual expenditure among other week periods with a value of Rp. 179,095,228.07 and Rp. 190,852,624.72. Likewise, in the 13th week, the budgeted cost for planning is Rp. 195,566,125,65 but in actual implementation the project completion only requires Rp. 37,869,754.33 so that there is a difference of Rp. 157,696,421.32. With the achievement of the difference or the difference between the planned costs and the actual costs used in project implementation, illustrates the dynamic dynamics due to conditions that are influenced by the ability of project management to achieve project goals. However, it is the results of the analysis of the project's cost performance that will later be able to provide an assessment of whether project management is effective enough in achieving project

goals and objectives.

In Table 2 it is also obtained that the value of the actual expenditure on the project object studied cumulatively is Rp. 1,367,150,467.79 (#One billion three hundred sixty-seven million one hundred and fifty thousand four hundred sixty-seven point seventy-nine rupiah#). The amount of the project's actual expenditure costs in a cumulative amount for a 90-day duration of project implementation, in the concept of resultant value is called the Actual Cost for Work Performed (ACWP) variable.

Suharto (1995) explained that the earned value method is used to measure project performance by comparing the budgeted work value with the actual completed work to determine whether the cost performance is still as planned. Based on the data obtained in this study, the results of the calculation of the earned value are shown in Table 3 as bellow:

Table 3. Actual Cost of Drainage and Sidewalk Rehabilitation of JalanTeuku Umar Package I

Observation Period		Weight of Completion of Actual Project Implementation (%)	Result Value according to Project Actual Implementation (BCWP Variable) (Rp)
Week-	Days to-		
1	6	0,46	6.643.040,07
2	13	10,23	147.735.434,59
3	20	23,33	336.917.662,66
4	27	30,83	445.228.098,57
5	34	39,13	565.091.647,65
6	41	44,33	640.186.883,22
7	48	49,93	721.058.675,37
8	55	56,23	812.039.441,54
9	62	61,11	882.513.431,84
10	69	75,07	1.084.115.256,56
11	76	84,63	1.222.174.958,88
12	83	97,23	1.404.136.491,22
13	90	100,00	1.444.139.145,55

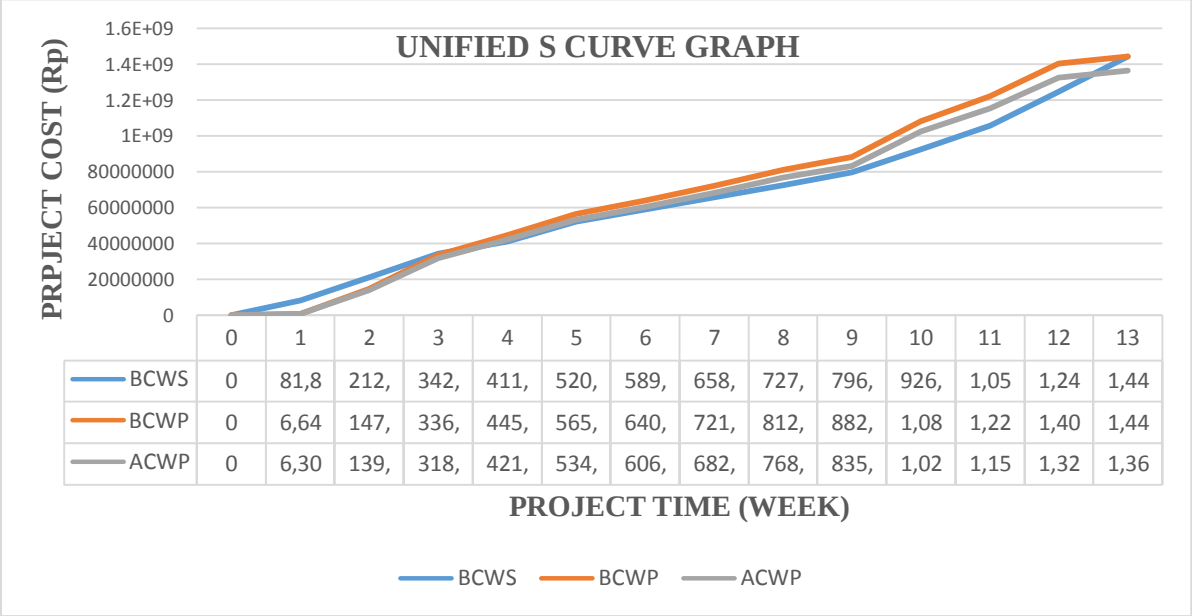
Source: Barokah, CV (2021)

As presented in Table 3 above, it can be observed that the percentage of work completion weight (%) and the results of calculating the results obtained are in accordance with the completion weights in the implementation of the project under study. In the table it can be explained that based on the weight of project completion (%) it is known that at the beginning of the implementation in the 1st week the project was running slowly, then increased in the 2nd week to the 9th week, and peaked at the 10th, 11th week. and the 12th experienced an unusually fast pace until the 13th week the project was completed. The earned value is the result obtained based on the work that has been completed and is calculated based on the percentage of weight obtained multiplied by the cumulative budget (contract value). Based on the earned value that have been obtained in the implementation of the project on the object under study in the cumulative sum obtained the amount of Rp. 1,444,139,145,55 (#One billion four hundred forty-four million one hundred and thirty-nine thousand one hundred and forty-five point fifty-five#), in the earned value concept is called the Budgeted Cost for Work Performed (BCWP) variable. To get the result value in the 10th week and 69th day of observation period as shown in Table 3 above, it can be obtained in the following calculation:

CALCULATING FORMULA BCWP VARIABLE
BCWP calculation =Completion weight (%)x Comulative budget
= (75,07%: 100%) xRp. 1.444.139.145,55
=Rp. 1.084.115.256,56

In this study, according to the object of the project being studied, the shape of the S curve is

obtained which consists of a combination of the X axis which represents the observation period from the 1st week to the 13th week (13 weeks of observation) and the Y axis which represents the result value variables can already be observed regarding the cost performance of project implementation. Based on the data obtained in the research on the implementation of the Teuku Umar Road drainage and sidewalk rehabilitation project package I, the shape of the S curve can be presented in Figure1 on the following as:



	0	1	2	3	4	5	6	7	8	9	10	11	12	13
BCWS	0	81,8	212,	342,	411,	520,	589,	658,	727,	796,	926,	1,05	1,24	1,44
BCWP	0	6,64	147,	336,	445,	565,	640,	721,	812,	882,	1,08	1,22	1,40	1,44
ACWP	0	6,30	139,	318,	421,	534,	606,	682,	768,	835,	1,02	1,15	1,32	1,36

Figure 1. S Curve of Cost Performance of the Analyzed Project

In Figure 1 above, it is shown that the BCWS variable, ACWP variable and BCWP variable reflect the project's cost performance status. The curve shows that the actual cost of project implementation (ACWP variable) is marked with a gray line, the project implementation budget cost (BCWS variable) is marked with a blue line, and the project yield value (BCWP) is marked with an orange line. In the integrated analysis of variance presented with the S curve, the X axis represents the duration of project implementation consisting of 13 observation periods (1st period to 13th period) and the Y axisrepresents the cost of project expenditure which consists of the project plan budget, the actual cost of project expenditure and the value of the results of project implementation. With the achievement of the position of the 3 variables shown on the formed S curve, the 3 variables are seen to form a curve that shows the image of all three in gray, blue and orange. In the formed S curve, it is shown that the ACWP variable runs lower than the BCWP variable starting at week 7, week 8 until it continues until week 13 and the distance continues to widen until the end of the project duration. This indicates that the cost performance status of the project in the implementation of the drainage and sidewalk rehabilitation of JalanTeuku Umar package I shows that the actual costs are smaller than the planned budget and a cost underrun position can be achieved with a project cost savings of Rp. 76,988,677,76. As for the Budgeted Cost of Work Schedule (BCWS) variable, the budget value for a work package combined with its implementation schedule marked with a blue line looks slightly different from the first two variables, namely the Actual Cost of Work Performed (ACWP) variable and the the second is the Budgeted Cost of Work Performed (BCWP) variable because the planning value with the work is not appropriate in completing the work implementation as a result of the progress formed from the physical weight of the work, materials and wages of workers but with the same results at the end of the 13th week period according to obtained from the image of the S curve above.

2. Project Cost Performance AnalysisBased on Earned Value Indicator

To be able to show the status of project cost performance in more depth in the

implementation of the drainage and sidewalk rehabilitation of JalanTeuku Umar package I, the analysis is continued by calculating the cost variance indicator. This indicator shows the status of the project related to project cost performance, which can state how much the actual cost of project implementation exceeds the planned budget cost, the condition of project implementation that reaches right on budget, or even status can be determined if it occurs budget savings in project expenditures (cost underrun). Cost variance is the difference between the value obtained after completing work packages and the actual costs incurred during project implementation. A positive cost variance indicates that the value of the work packages obtained is greater than the costs incurred to work on these work packages, whereas a negative value indicates that the value of the completed work packages is lower than the costs already incurred.

Based on the formula for calculating the value of the cost variance indicator and its probability/opportunity, it can be a negative number, a positive number, or a 0. Based on the values obtained in these indicators, the project cost performance status will be explained. By using this formula, it can be used in the project analyzed in this case study. Based on the results of the analysis of project cost performance on the implementation of the drainage and sidewalk rehabilitation of JalanTeuku Umar package I, the results of the cost variance indicators are obtained as observed in Table 4 on the following:

Table 4. Indicators of Cost Variance for Rehabilitation of Drainage and Sidewalks for JalanTeuku Umar Package I

Week of observation	Variable		CV indicator	Project implemention cost performance
	BCWP (Rp)	ACWP (Rp)		
1	6.643.040,07	6.300.162,31	342.877,76	Budget cost>actual cost
2	147.735.434,59	139.869.656,83	7.865.777,76	Budget cost > actual cost
3	336.917.662,66	318.964.884,90	17.952.777,76	Budget cost > actual cost
4	445.228.098,57	421.500.320,81	23.727.777,76	Budget cost > actual cost
5	565.091.647,65	534.972.869,89	30.118.777,76	Budget cost > actual cost
6	640.186.883,22	606.064.105,46	34.122.777,76	Budget cost > actual cost
7	721.058.675,37	682.623.897,61	38.434.777,76	Budget cost > actual cost
8	812.039.441,54	768.753.663,78	43.285.777,76	Budget cost > actual cost
9	882.513.431,84	835.470.054,08	47.043.377,76	Budget cost > actual cost
10	1.084.115.256,56	1.026.322.678,80	57.792.577,76	Budget cost > actual cost
11	1.222.174.958,88	1.157.021.181,12	65.153.777,76	Budget cost > actual cost
12	1.404.136.491,22	1.329.280.713,46	74.855.777,76	Budget cost > actual cost
13	1.444.139.145,55	1.367.150.467,79	76.988.677,76	Budget cost > actual cost

Source: Processed data (2021)

In Table 4 above, based on the calculation of the BCWP variable value minus the ACWP variable value, a cost performance indicator is obtained which is called cost variance. In the table, the CV size is shown starting from the 1st week, 2nd week, 3rd week to the next weekthe end of the project implementation in the 13th week everything went on a positive number. The increasing duration of project implementation, the value of the CV indicator also increases, starting in the 1st week of Rp. 342.877.76, 2nd week of Rp. 7,865,777.76 and until the 13th week of Rp. 76,988,677,76. With the achievement of the cumulative CV indicator value of Rp. 76,988,677,76 on the object of the project under study, then the actual cost of project financing is more efficient than the project budget plan. Thus, it can be said that in the implementation of the project the actual cost was saved in the amount of Rp. 76,988,677,76. To get the value of the savings that occur, it is done by calculating the value of the CV indicator in the 13th week of observations of the project that is the object of research, then it is obtained by calculating the following formula:

CALCULATING FORMULACOST VARIANCE INDICATOR
CV indicator = BCWP variable –ACWP variable
=Rp. 1.444.139.145,55 – Rp. 1.367.150.467,79
=Rp. 76.988.677,76

According to Ervianto (2005), it is stated that the actual volume cost is smaller than the actual cost, resulting in project cost savings, this condition is called cost underrun. Likewise, Patiarsa (2015) states the same thing regarding CV has a positive value, namely that in project implementation there are more costssmaller than budget. Thus, the performance of the cost performance carried out on the project has shown that work has been optimal and costs can be controlled very well.

3. Project Cost Performance AnalysisBased on Earned Value Index

The next project cost performance analysis shows the project cost performance status on the implementation of the drainage and sidewalk rehabilitation of JalanTeuku Umar package I, then the analysis continues with the calculation of the CPI index. To further demonstrate and increase confidence that there have been savings in project implementation on the object under study, the analysis needs to be continued by calculating the cost performance index (CPI). The cost performance index is calculated by dividing the BCWP variable with the ACWP variable. The cost performance index (CPI) shows that the cost efficiency factor that has been spent can be shown by comparing the value of the work that has been physically completed (BCWP) with the costs that have been spent in the same period (ACWP). This CPI value shows the weight of the value obtained (relative to the overall project value) against the costs incurred. CPI less than 1 indicates poor cost performance, because the costs incurred (ACWP) are greater than the value obtained (BCWP) or in other words waste occurs. Based on the value of the BCWP variable and the ACWP variable value on the object under study, the results of the calculation using the concept methodthe value of the results obtained by the index of the cost performance index (CPI) as presented in Table 5 as follows:

Table 5. Cost Performance Index (CPI) for Drainage and Sidewalk Rehabilitation of JalanTeuku Umar Package I

Week of observation	Variable		CPI index	Project implemention cost performance
	BCWP (Rp)	ACWP (Rp)		
1	6.643.040,07	6.300.162,31	1,05	Cost underrun
2	147.735.434,59	139.869.656,83	1,06	Cost underrun
3	336.917.662,66	318.964.884,90	1,06	Cost underrun
4	445.228.098,57	421.500.320,81	1,06	Cost underrun
5	565.091.647,65	534.972.869,89	1,06	Cost underrun
6	640.186.883,22	606.064.105,46	1,06	Cost underrun
7	721.058.675,37	682.623.897,61	1,06	Cost underrun
8	812.039.441,54	768.753.663,78	1,06	Cost underrun
9	882.513.431,84	835.470.054,08	1,06	Cost underrun
10	1.084.115.256,56	1.026.322.678,80	1,06	Cost underrun
11	1.222.174.958,88	1.157.021.181,12	1,06	Cost underrun
12	1.404.136.491,22	1.329.280.713,46	1,06	Cost underrun
13	1.444.139.145,55	1.367.150.467,79	1,06	Cost underrun

Source: Processed data (2021)

As shown in Table 5, it is shown that the cost performance index in the 1st week until the end of the project in the 13th week of the project that is the object of research is entirely scored more than 1. 1st week achieved index = 1.05, in the 2nd week index = 1.06 and the 3rd week index = 1.06 until the last week, namely the 13th week, the index = 1.06. With the achievement of the cost performance index and cumulatively obtained a CPI index of 1.06 has provided clear and convincing instructions that it is true that there have been cost savings in the implementation of the object that is the object of research. This is in accordance with what was stated by Pastiarsa (2015) that with the achievement of a cost performance index (CPI) > 1, it means that the project is running at a cost that is more efficient than the budget. To get the CPI index value as listed in the table at week 13, it can be obtained by calculating the following formula:

CALCULATING FORMULACOSTPERFORMANCEINDEX
CPI Index =BCWPvariable :ACWP variable
=Rp. 1.444.139.145,55 :Rp. 1.367.150.467,79
=1,06

Cost performance index (CPI) is used to determine the cost status of project implementation, the magnitude of the achievement of this value can be explained by the conditions that can be observed on the following page.The conditions for achieving the CPI index score are as follows:

1. CPI = 1, meaning that the project implementation costs are in accordance with the planned budget.
2. CPI > 1, meaning that the project implementation cost is smaller than the planned budget.
3. CPI < 1, meaning that the project implementation cost is greater than the planned budget.

Thus, the actual cost savings of the project will occurbudget on the project that became the object of research with the achievement of a cost performance index of 1.06 and a cost variance of Rp. 76,988,677.76 (#Seventy-six million nine hundred eighty-eight thousand six hundred seventy-seven point seventy-six rupiah#) indicates that the project implementer will definitely benefit from the project being undertaken. With the budget in accordance with the Draft Budget for the implementation of the Teuku Umar Road drainage and sidewalk rehabilitation project package I, the occurrence of budget savings can be calculated as follows:

PROJECT COST SAVINGS CALCULATION
Cost savings (%) =(Rp. 76.988.677,76: Rp. 1.444.139.145,55)x100%
=5,33 %

With the acquisition of cost performance which has shown a budget savings of 5.33%, it is sufficient to provide a proud work performance for construction service providers or can be called project implementers. This must continue to be maintained in an effort to control costs on the project so thatthe occurrence of cost performance performance will always show budget cost savings in project implementation.

IV. CONCLUSION

Based on the results of the performance analysis using the earned value analysis method obtained in this study, several conclusions can be drawn regarding the implementation of the drainage and sidewalk rehabilitation project of JalanTeuku Umar package I, including the following:

1. The results of the CV (cost variance) calculation starting from the 1st week, 2nd week, 3rd week until the end of the project implementation period on the 13th week all run in positive numbers. The increasing duration of project implementation, the value of the CV indicator also increases, starting in the 1st week of Rp. 342.877.76, 2nd week of Rp. 7,865,777.76 and until the 13th week of Rp. 76,988,677,76. With the achievement of the cumulative CV indicator value of Rp. 76,988,677,76 on the object of the project under study, then the actual cost of project financing is more efficient than the project budget plan. Thus, it can be said that in the implementation of the project the actual cost was saved in the amount of Rp. 76,988,677,76.
2. Cost performance index (CPI), resulting in an analysis of cost performance for thirteen weeks of project implementation starting from the 1st week to the 13th week showing a stable CPI value of more than 1 (one) means that in week 1 to week 13 the actual costs incurred are less than the budgeted allocation of funds. In other words, the construction service provider/contractor/project implementer still has a very good level of sensitivity in controlling project implementation cost performance and can achieve a cost underrun position.

BIBLIOGRAPHY

[1.] Ali, H. 1995. Prinsip-prinsipJaringanKerjaProyek (Project Network Planning). Penerbit PT. Gramedia, Jakarta.
[2.] Barry, Donald S; Boyd C. Paulson andSudinarto. 1998. ManajemenKonstruksiProfesional. PenerbitErlangga, Jakarta.
[3.] Clough, Sears. 1991. PerencanaandanPengendalianWaktu. PenerbitPrenada Media, Jakarta.
[4.] Dipohusodo, I. 1996. ManajemenProyekdanKonstruksi. PenerbitKanisius, Jakarta.
[5.] Ervianto, Wulfram I. 2004. Teori-AplikasiManajemenProyekKonstruksi. PenerbitAndi Offset, Yogjakarta.
[6.] Ervianto, Wulfram I. 2005. Teori-AplikasiManajemenProyekKonstruksi. PenerbitAndi Offset, Yogjakarta.
[7.] Flemming, Q.W and Koppelman J. M. 1994. The Essence and Evaluation of Earned Value. Penerbit AACE Transaction, Boston USA.
[8.] Gray and Larson. 2007. Project Management. Bosyo: Irwin McGraw-Hill, London.
[9.] Handoko, T. H. 1999. ManajemenPersonaliadanSumberDayaManusia. Penerbit BPFE. Yogyakarta.
[10.] Hughes, Bob and Mike Cotterell. 2002. Software Project Management. 3rd edition. Penerbit McGraw-Hill, London.
[11.] Husen, Abrar. 2009. ManajemenProyek. PenerbitAndi Offset, Yogyakarta.
[12.] Husen, Abrar. 2011. ManajemenProyek. PenerbitAndi Offset, Yogyakarta.
[13.] Johan, dkk. 1998. Trade-OffWaktudanBiayapadaProyekKonstruksi (StudiKasuspadaProyek Kantor Bank Metro). Engineering journal of Engineering Faculty Airlangga University, Surabaya.
[14.] Kerzner. 1982. Project Management: A System Approach do Planning, Schedule and Controlling. Van Nostrand Reinhold, New York.
[15.] Nugraha, P. I. Natan and R. Sutjipto. 1985. ManajemenProyekKonstruksiJilid I dan II. PeberbitKartikaYudha, Surabaya.
[16.] Pastiarsa, Made. 2015. ManajemenProyekKonstruksiBangunanIndustri: PerspektifPemilikProyek. PenerbitTeknosain, Yogjakarta.
[17.] Project Management Institute USA. 2004. A Guide to the Project Management Book of Knowledge (PMBOK). PMI Inc., Pennsylvania USA.
[18.] Rani, Hanifdar A. 2016. ManajemenProyekKonstruksi. PenerbitDeepublish, Yogjakarta.
[19.] Santoso, Budi. 2009. ManajemenProyek: KonsepdanImplementasi. PenerbitGrahaIlmu, Yogjakarta.
[20.] Schwalbe, Kathy. 2004. Information Technology Project Management. 4th edition. The Course Technology, Inc. Boston USA.
[21.] Soeharto, Iman. 1995. ManajemenProyek: Dari KonseptualSampaiOperasional.3rd edition. PenerbitErlangga. Jakarta.
[22.] Soeharto, Iman. 1999. ManajemenProyek Dari KonseptualSampaiOperasional. PenerbitErlangga. Jakarta.
[23.] Soemardi, B. W. 2007. ManajemenPersonaliadanSumberDayaManusia. Penerbit BPFE, Yogjakarta.
[24.] Sugiyanto. 2020. Manajemen Pengendalian Proyek. Penerbit Scopindo Media Pustaka, Surabaya.
[25.] Tjaturono. 2006. ManajemenKonstruksi. BahanKuliahPascaSarjana Magister Teknik. InstitutTeknologiNasional, Malang.
[26.] Triton, PB. 2005. ManajemenDivestasiProyek: AnalisisdanStrategi. PenerbitTugu Publisher, Yogjakarta.
[27.] Wardjito. 2003. StudiPenelitianProduktifitasTenagaKerjaBangunanuntukMeningkatkanKinerja. TesisInstitutTeknologiNasional, Malang.
[28.] Widiasanti, Irika and Lenggogeni.2014. ManajemenKonstruksi. Penerbit PT. RemajaRosdakarya, Bandung.
[29.] Winoto, Agnes DwiYanthi. 2014. ManajemenKonstruksiuntukBangunan. Penerbit PT. Taka Publisher, Yogjakarta.
[30.] Yahya,I. G. D. 2013. StudiPengendalianBiayadanJadwalProyekdenganMenggunakanNilaiHasil. Skripsitidakpublikasi. UniversitasHasanuddin, Makasar.

International Journal of Innovation Engineering and Science Research
(ISSN: 2581-4591)
www.ijiesr.com

A Comparative Study of 2D Human Pose Estimation Methods

[1]Felix Pîrvan, [2]Daniela Hagiescu
Advanced Slisys
Bucharest, Romania

ABSTRACT

Human pose estimation is the process of detecting the key points or landmarks of the human body. Face pose estimation and hand pose estimation are the two most common special cases. In this paper, we will focus on the body as a whole. Human pose estimation is used in various subsequent tasks, such as action recognition or motion characterization. We are presenting the main types of approaching the problem and the different techniques and architectures involved. We are also discussing the evaluation datasets available and their features. The field has seen fabulous progress in later years since the advent of deep learning.

Keywords—*human pose, pose estimation, keypoint, landmark, human body, deep learning*

I. INTRODUCTION

Human pose estimation (HPE) involves detecting the positions of the human body parts, given as input some sensor data. Input data often comes from one or more cameras. A single camera can be RGB or RGB-D (depth) camera, while stereo camera systems can also be used. Sometimes video sequences are available, and this helps by imposing additional consistency constraints on the HPE from each single image. Applications of HPE range from movies to healthcare, from virtual reality to autonomous cars and from surveillance to robotics.

Some HPE methods use a body model that makes connections between the skeleton joints, based on prior knowledge about the human body structure. The most commonly used body model is skeleton-based. It describes the connections between different joints of the skeleton. The HPE task comes down to estimating the 2D or 3D coordinates of the skeleton joints.Other methods do not use joint connections, hence they are faster, but can be prone to errors when encoutering an unseen pose. Some HPE methods use a top-down approach, where they first detect all the persons in the image and then estimate the pose of each person. Other methods work bottom-up, first detecting all the joints and then grouping them by persons. The more persons in the image, the more time needed for top-down methods, while the bottom-up methods maintain a constant time. However, when persons overlap, bottom-up methods encounter difficulties matching the joints to the right person. Some methods use other kind of body parts in addition to the joints, like the limbs. Some HPE methods directly regress the coordinates of the joints, while others try to detect the image patches around the joint or use heat maps instead of point locations. Single-stage HPE methods are more compact are easier to train end-to-end, while multi-stage methods can offer more flexibility and make it easier to pinpoint the issues that occur in one stage or another.

In our attempt to summarize the present state of the field, we build upon previous work. In [1], the authors focus on single-camera (monocular) HPE and discuss separately the 2D and 3D methods, present the datasets and the metrics used for evaluation. Even more recently, [2] presents several body models and then many 2D and 3D methods grouped by approach (top-down or bottom-up), including a performance comparison. In this paper, our approach is to select and focus on the most widely used datasets and the most successful methods and their techniques. The field is already vast enough to get lost, so our goal is to bring worward the most promising results.

II. DATASETS

In order to train and evaluate different HPE methods, several datasets have been made publicly available. They all maintain a competition ladder with the best scoring methods. Those datasets have put together a set of images or video sequences containing the full body of one or more persons. They defined a set of keypoints and annotated each image with the positions of all defined joints. As you can see in Figure 1, the set of keypoints differs from one dataset to another, making it difficult to use all of them together.

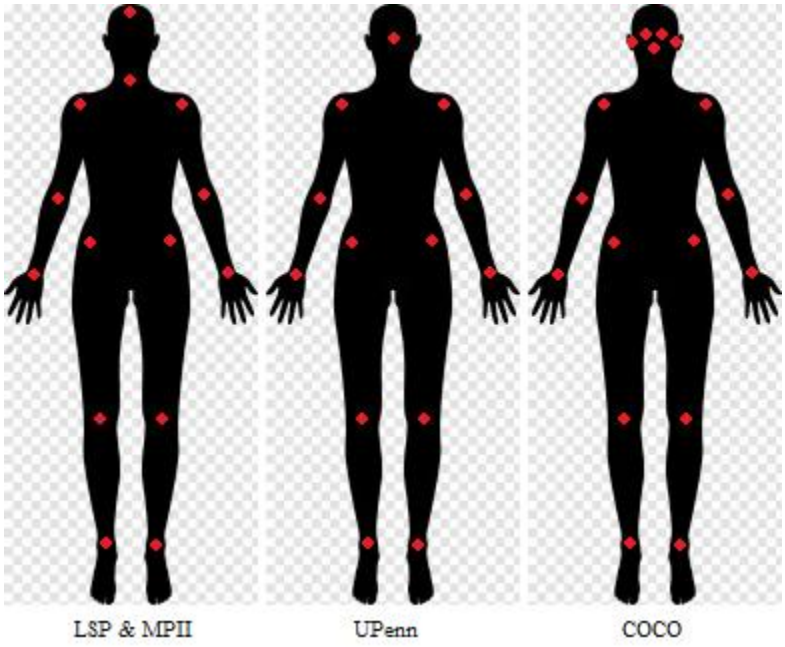


Fig. 1 Keypoints annotated by some of the most used datasets

Leeds Sports Pose (LSP) has two versions: original and extended. Together, they contain 12.000 images of persons during sport activities, crawled from Flickr. Each person is annotated with a 14 keypoints: top of the head, neck, shoulders, elbows, wrists, hips, knees and ankles. A visibility flag for each key pointis also stored. The images are scaled as to make the annotated person 150 pixels in height.

MPII Human Pose is a dataset put together by the Max Planck Institute for Informatics. It contains around 25.000 images extracted from Youtube videos. The images may contain more than one persons, for a total of 40.000 annotated persons. It uses the same set of keypoints as the LSP dataset. It also annotates the type of activity the person is doing, for a total of 410 activity types. The activities are grouped by category, e.g. bicycling, dancing, home repair, music playing, self care, transportation and others.

Penn Action is dataset built by the University of Pennsylvania. It contains over 2300 video sequences of maximum resolution 640x480 pixels, with all frames annotated, making up for 330.000 frames with 330.000 instances of 2300 persons. However, these numbers should be regarded with caution, as the frames from the same video are not independent. There are 13 annotated keypoints (head, shoulders, elbows, wrists, hips, knees and ankles), as well as 15 actions (e.g. baseball swing, bowling, squats, tennis serve). Labels also include the visibility of each keypoint, the viewpoint (front, back, left, right), the bounding box of the person.

COCO-WholeBody is an extension of the COCO dataset with around 200.000 images and 250.000 annotated persons. In addition to the 17 generic body key points (nose, eyes, ears, shoulders, elbows, wrists, hips, knees and ankles), it also defines and annotates 68 key points for face, 42 for hands and 6 for feet. The bounding box for the body is also provided.

TABLE I. DATASETS

Dataset	Images	Videos	Persons	Key points	Actions
LSP	12.000	-	12.000	14	8
MPII	25.000	-	40.000	14	410
UPenn	-	2300	2300/330.000	13	15
COCO	200.000	-	250.000	17	-

III. BEST RANKING METHODS

Zoom Net [3] is a deep neural network introduced by the same team that built COCO-Whole Body dataset. It takes into account the hierarchical structure of the human body to solve scale variations of certain body parts of the same person. The Faster RCNN architecture is used to extract the person bounding boxes from the image. So this paper is using a top-down approach. Then for each person,

ZoomNet first extracts some features from the image, then detects the body key points , then, based on the position of the hands and head, zooms in to detect the hand and the face key points . Hence, it has 4 parts (subnets): FeatureNet, BodyNet, FaceHead, HandHead. BodyNet uses HRNet-W32 as backbone, while the heads for face and hand use HRNetV2p-W18 as backbone. The authors point out several factors that influence the accuracy of the system. Using ground truth (GT) bounding boxes for the persons, the accuracy improved by 23.6%. Medium scale persons yield better results than large scale persons, because the accuracy is measured relative to the person size.

Key point Communities [4] detects key points not only on persons, but also on objects (e.g. cars). The method is based on the concept of community. It builds a bottom-up graph of key points and uses a connectivity measure to group them by person or object. The key points are assigned weights according to their importance relative to an ego graph. Groups of key points can be important, even if the individual key points within the group are not so important. The ego graphs are based on the euclidean distance between pairs of key points . The method uses the concept of graph centrality that gives importance to the more central nodes of the graph, like in the case of a social network. The backbone is ShuffleNetV2. Ablations are performed with respect to the key pointweighting method.

HR Pose [5] focuses on learning high-resolution representations even in the deepest levels of the convolutional neural network. To this end, the network keeps the big feature maps until the end, but in parallel also adds 3 more series of smaller feature maps, which repeatedly receive information from the biggest feature maps through fusions. Each series of feature maps has the same width throughout, which is half the width of the previous series maps. High-to-low fusions are strided convolutions, while low-to-high fusions are realized through up-sampling. The network regresses a heat map for each keypoint. The authors experimented with two architecture sizes: HRNet-W32 with feature map widths of 256, 128, 64 and 32, and HRNet-W48 with feature map widths of 384, 192, 96 and 48. The method was trained and evaluated separately on MPII and COCO datasets.

HPR Net [6] is a bottom-up method that detects all the 133 key points in the COCO-WholeBody dataset in a single shot. It addresses the scale issue of the different body parts by building a point representation of body parts and then regressing them all at once. The face key points are regressed relative to the center of the face and similarly, the hand key points relative to the hand center. Tipically for bottom-up methods, the time consumed is constant: it does not depend on the number of persons in the image. After an Hourglass-104 backbone that extracts the shared features, the network has 7 heads, one for each of the person center heatmap, person center correction, person box, body key pointheatmaps, body key pointoffsets, hand key pointoffsets, and face key pointoffsets.

Open Pose[7] is a bottom-up method that learns to associate body parts to persons in a greedy manner, thus being able to perform the computations in real time. The key pointlocations and their associations are learned simultaneously by the two branches of the network. Key pointlocations are predicted as heat maps, while the association between key points is represented as vector fields, which help decide which key points are connected and thus construct a skeleton for each person in the image. The network has several stages, each stage taking as input the output of the previous one, concatenated to the image features. The field of affinities is defined on a limb (the segment between two connected key points) as unit vectors with direction along the limb. The field takes zero values elsewhere. In terms of speed, this method achieved 8.8 fps (frames per second) on a video with 19 persons.

Soft-Gated Skip Connections [8] (SGSC) proposes gated skip connections with learnable parameters for each channel, instead of the usual plain skip connections, a mechanism meant to control the data flow through each channel. In addition, the authors use a hybrid network constructed by combining a heavier Hourglass and a lighter U-Net architecture, achieving the same performance as the heavy Hourglass but with 3 times fewer parameters. Regarding the skip connections, this method proposes two novelties. First, the gate per se is represented by a special module composed of three convolutions. Second, the encoder features are merged into the decoder by concatenations instead of summation.

Cascade Feature Aggregation [9] (CFA) proposes a deep neural network composed of multiple Hourglass stages with abundant feature aggregations and fusions between stages, meant to improve the key point localization, but also to make the network robust to unusual poses, occlusions and low resolution images. Final prediction is averaged across the predictions (heat maps) of each stage except the first. The typical hourglass architecture is improved by using ResNet blocks in both encoder and decoder. As it is hard to achieve convergence from scratch with random initialization for a network like this with more than 3 stages, the authors trained first a 3-stage network and than used the learned parameters to initialize the 4^{th} stage, then train the final 4-stage network.

TransPose [10] uses the Transformer architecture, which is able to reveal the local dependencies that the network constructs and uses to predict a certain keypoint. For example, the attention maps of the

Transformer reveal that predicting the position of an occluded left ankle depends on the left knee and left hip, but also on the right ankle and right knee positions. These dependencies are image-specific. The network starts with some convolutional blocks (the backbone), followed by three attention stages. For the preliminary convolutional blocks, it uses only the first part of HRNet, accounting for a small fraction of their total number of parameters. The subsequent attention stages are implemented by standard Transformer encoders. A head is appended to predict the key pointheat maps.

UniPose [11] achieves human pose estimation in a single stage, incorporating contextual segmentation and joint localization. It uses a waterfall architecture for progressive filtering and in the same time keeps the multi-scale receptive field typical for pyramidal configurations.The network has a ResNet-101 backbone, followed by a WASP (waterfall atrous spatial pooling) module, followed by a decoder that outputs heat maps for the key points . Dilated (atrous) convolutions increase the receptive field while avoiding downsampling.This network also has an extension, UniPose-LSTM, dedicated to pose estimation from video sequences. The LSTM module is placed after the UniPose network and predicts another set of heat maps for the key pointlocations. The LSTM also receives as input its own predictions from the previous frame, achieving temporal consistency.

Multi-Stage Pose Network[12] (MSPN) proposes a multi-stage design, cross-stage aggregation of the features, and coarse-to-fine supervision. The network is composed of 8 feature pyramids grouped in 4stages. In each stage, the first pyramid is series of 4 downscaling layers, while the second is a sequence of 4 upscaling layers, informed by the corresponding layers from the first pyramid. The output of the top-most layer of the second pyramid in the first stage is the input for the first pyramid in the second stage. Feature aggregation between stages is preceded by 1x1 convolutions. Each layer contributes to the prediction.

Spatial Context Network [13] (SCN) uses contextual information in two different ways. Cascade Prediction Fusion (CPF) is a technique that accumulates prediction from the previous stage and guides the prediction of the following stage. Pose Graph Neural Network (PGNN) captures the relations between human joints as a graph, with messages passing through the graph edges, between connected joints. Ambiguities in key pointlocations from earlier stages are gradually resolved in later stages. CPF comes first, and its predictions are refined by PGNN. The body model includes not only skeleton-based connections, but also some long-distance connections (e.g. between ankle and hip). The backbone is an 8-stack Hourglass. Ablation studies show 0.4 metric points improvement when adding CPF over the backbone baseline and a further 0.8 points when also adding PGNN.

OmniPose [14] is an improvement on UniPose [11], by the same authors. It uses multi-scale feature representations which incorporates contextual information through the innovative Waterfall module, which uses a large receptive field while keeping the high resolution of the feature maps. Also, the WASP module from [11] now acts also as a decoder, reducing the network complexity. The backbone is a modified 3-stage HRNet, where deconvolutions with Gaussian heat maps modulations replace the standard upsampling. Separable convolutions are used to reduce the number of parameters.

Adversarial Data Augmentation [15] (ADA) is a technique meant to unify data augmentation and training in the same process, using a generative adversarial network (GAN). The generator produces progressively harder augmentations trying to fool the discriminator, which in turn makes progressively accurate predictions. The two components are jointly trained. The training network (the discriminator) is U-Net shaped and decides between standard and generated augmentations, according to a typical HPE loss function. The augmentation network (the generator) is informed by the encoding part of the discriminator's U-Net and outputs distributions of mixed Gaussians, from which scaling and rotations are sampled. Occlusions are generated in the U-Net at the smallest scale.

Pyramid Residual Modules [16] (PRMs) learn convolutional filters on various scales of the input features, aiming to better detect the key points in unusual poses or in foreshortened body parts, where the relative scale of certain parts to the others is rather uncommon.The network is composed of stack Hourglass modules, preceded by PRMs. Each PRM has a branch for each scale and the features on each branch are downscaled and then upscaled. In addition, the authors note that Xavier initialization leads to increasing variance in the multi-branch networks, so they lay out a theoretical basis for a new type of initialization for such networks.

LSTM Pose Machines [17] (LSTM PM) is designed to estimate human pose in video sequences. Specific challenges are the consistency from frame to frame that can cause flickering, as well as the low quality of some frames, due to motion blur. The authors note that a multi-stage convolutional neural network (CNN) with sharing weights can be rewritten as a recurrent neural network (RNN), which is well suited for the task. Long Short-Term Memory (LSTM) units are inserted between the frames to ensure temporal geometric consistency. The optimal number of LSTM iterations is found to be 5, corresponding to the number of past frames that are still useful for the current frame prediction.

Thin-Slicing Network [18] (TSN) targets video sequences and uses a body model as prior knowledge, in order to ensure temporal consistency. The network can represent both the appearance and the spatio-temporal relationship between the key points . It takes several consecutive frames as input and predicts initial key pointlocations, while also computing the dense optical flow between the frames. Then a spatio-temporal layer passes messages iteratively through the edges of a loopy graph representing a spatio-temporal view of the body model, yielding the final predictions. For example, the right ankle from the current frame is linked with the right knee from the current frame, but also with the right ankle from the previous frame.

DarkPose [19] relies on extracting the right key pointlocation from the predicted heat map, as well as the encoding of the GTs as heat maps. Usually the heat maps are predicted at a lower resolution than the original and they have to be scaled back. It is also supposed that the heatmaps would have near-Gaussian shape, but the authors found that this is often not the case. So they first modulate the low resolution heat maps through a convolution with a Gaussian kernel. On the other hand, the GT encoding suffers from quantization error, when the heat map is generated after the image is scaled down. So the authors renounced the quantization altogether. Best results are achieved with an HRNet backbone. This method still works fairly well for low resolution inputs, for with a much reduced network complexity is needed, so it can be very fast.

Cascaded Pyramid Network [20] (CPN)is a top-down approach that, after person bounding box detection, has two stages, called GlobalNet and RefineNet. GlobalNet is a feature pyramid that detects the easier key points , but struggles with the harder one, affected by occlusion or difficult background. RefineNet integrates the feature representation from the first stage and uses hard key pointmining to give more weight in the loss to the harder key points . The authors also investigate different non-maximum suppression (NMS) thresholds for the bounding box detection, and find that Soft-NMS is the best choice. Also, as backbone, Resnet-50 is found to be superior to 8-stage Hourglass. In addition, ensemble models give the best results.

OpenPifPaf [21] proposes a bottom-up, single-stage network for real-time key pointdetection and tracking, applicable not only to persons, but also to cars and animals, with direct applicability to self-driving cars and delivery robots. It defines a spatio-temporal pose as a graph spanning multiple frames. Composite Intensity Fields (CIF) are confidence maps that reach maximal values in the vicinity of key pointlocations. Composite Association Fields (CAF) regress the locations of source and target joints, for each limb and for each point in the image, and also the size of each joint. The network can be trained jointly on multiple datasets. At training time, the input is several consecutive frames, while at inference time an additional layer is inserted that merge the features cached from the previous frame into the current features. The body model has redundant connections, which helps with the occluded joints or sparse pose, where the visible body parts of a person are not direct neighbors.

Pose Residual Network [22] (PRN) is a bottom-up method that simultaneously handles key pointdetection, person detection and semantic segmentation. After the ResNet-101 backbone, the network splits in two branches, the key pointsubnet and the person subnet, the latter predicting bounding boxes, as well as segmentation. The two branches are then rejoinedby the final module, the actual PRN, which groups the key points by person. The key pointsubnet is composed of three successive feature pyramids.

IV. Summary of the Techniques

Most methods use an established backbone, sometimes in a slightly modified version, or taking only the relevant portion of it. Some methods use entirely custom built networks. The most common backbones are Hourglass, HRNet, ResNet and ShuffleNet. **Hourglass** is used by 6 methods ([6], [8], [9], [13], [15], [16]) and was first introduced as U-Net [23]. It shrinks progressively the input while encoding it, then the feature maps are enlarged back to original size in a symmetric manner.For the HPE task, there are usually many (8) Hourglass modules stacked back to back. **HRNet** [24] is used by 5 methods ([3], [5], [10], [14], [19]). It has 4 stages, from the first stage that contains feature maps only at the input resolution, to the last stage that contains feature maps at 4 different resolutions.**ResNet** [25] is used by 4 methods ([11], [12], [20], [22]) and it was the first to use residual (skip) connections to address the issue of vanishing gradients in deep networks.**ShuffleNet** [26] is used by 2 methods ([4], [21]). It uses group convolutions and channel shuffle to reduce the computational cost of the network.

The techniques used by the most successful methods can be summarized as follows:

- Multi-branch networks or subnets:[7], [16], [22]
- Averaging the predictions from several stages: [9], [12], [13]
- Graph neural network to emulate relationships between key points : [13], [18], [21]

- Body model: [3], [18]
- Vector fields for key pointaffinity: [7], [21]
- Feature aggregation between stages: [9], [12]
- WASP module for progressive filtering: [11], [14]
- LSTM for temporal processing: [11], [17]
- Gaussian heat map modulations for upscaling features [14] and predictions [19]
- Groups of key points : [4]
- Training progressively the multi-stage network: [9]
- Transformer as attention module: [10]
- GAN to generate hard augmentations during training: [15]
- Weight initialization specific to multi-branch networks: [16]
- Optical flow between frames: [18]
- Hard key pointmining: [20]
- Soft-NMS [27] to choose the person bounding box: [20]
- Semantic segmentation head: [22]

V. METRICS AND EVALUATION

The metric for the COCO dataset [28] is mean average precision (mAP), i.e. the mean over all classes (key pointtypes) of the average over all recall thresholds of the precisions of each keypoint. Object Key pointSimilarity (OKS) is used to measure the similarity between the prediction and the GT and it depends on the Euclidean distance between prediction and GT, the scale of the human body and the standard deviation of the human GT annotations.

The metric for LSP and UPenn datasets [29] is the probability of correct key point(PCK), which depends on the Euclidean distance between prediction and GT and the size of the person bounding box. The metric for MPII dataset (PCKh) [30] is a variant of PCK which depends on the size of the person's head, instead of its whole body size.

Table II shows the evaluation scores of the methods presented above. All times are obtained by the authors on an Nvidia GTX 1080 Ti GPU. Scores marked with asterisk (*) are obtained by training on additional data. Methods marked with a plus sign (+) were using an ensemble of models. Method complexity is expressed in GFlops (floating-point operations) and it depends on the network input size, hence on the dataset, therefore an interval is given for methods evaluated on multiple datasets. Time and complexity should be proportional.

TABLE II. EVALUATION OF HPE METHODS

Method	Backbone	Complexity [GFlops]	Time [ms]	mAP on COCO	PCKh@0.5 on MPII	PCK on LSP	PCK@0.2 on UPenn
DarkPose	HRNet-W48	32.9	N/A	**77.4**	-	-	-
OmniPose	custom HRNet	22.6-37.9	N/A	76.4	-	**99.5**	**99.4**
ZoomNet	HRNet-W32	27.36	175	74.3	-	-	-
CPN+	ResNet-50	13.9	N/A	73.0	-	-	-
OpenPifPaf	ShuffleNetV2K30	N/A	152	70.9	-	-	-
PRN	ResNet-101	N/A	N/A	69.7	-	-	-
KC	ShuffleNetV2	N/A	93	69.6	-	-	-
SGSC	custom Hourglass	9.9	N/A	-	**94.1***	94.8	-
CFA	custom Hourglass	73	N/A	-	93.9*	-	-
TransPose	reduced HRNet	21.8	27	-	93.5*	-	-
UniPose	ResNet-101	N/A	N/A	-	92.7	94.5	99.3

Method	Backbone	Complexity [GFlops]	Time [ms]	mAP on COCO	PCKh@0.5 on MPII	PCK on LSP	PCK@0.2 on UPenn
MSPN	4x ResNet-50	19.9	N/A	-	92.6	-	-
SCN	8x Hourglass	N/A	N/A	-	92.5	94.0	-
HRPose	HRNet	9.5-32.9	N/A	65.9	92.3	-	-
PRMs	8x Hourglass	14.7	N/A	-	92.0	93.9	-
ADA	GAN with U-Net	N/A	N/A	-	91.5	94.5	-
HPRNet	Hourglass-104	N/A	101	59.4	-	-	-
OpenPose	custom	N/A	100	56.3	88.8	-	-
LSTM PM	custom	N/A	N/A	-	-	-	97.7
TSN	custom	N/A	N/A	-	-	-	96.5

VI. Conclusions

State-of-the-art HPE methods all use deep neural networks, but a great variety of techniques. Most networks are pretty heavy and cannot be expected to run in real time, but some of them have lighter versions designed with speed in mind, while not compromising the accuracy too much. Top-down methods tend to perform better but are slower then bottom-up methods. Increasing the efficiency to make the methods more practical should be an important objective.

While very good results were obtained in most of the cases, there still remain challenges like unusual poses, occlusions, crowded people and low resolution images, or motion blur in the case of video sequences. In spite of this, some of the datasets have almost been saturated (see the high scores on LSP and UPenn), so maybe there is a need for a new, more difficult dataset. Synthetic data has not been used much and there is a virtually unlimited amount that can be generated, although it will bring the problem of domain adaptation.

Acknowledgment

The results presented in this work concerns the research carried out for the "SENTIR" research project, co-financed through the European Regional Development Fund, POC–A.1–A1.2.1–D–2015 grant, research, development and innovation supporting economic competitiveness and the development of businesses.

References

[1] Y. Chen, Y. Tian, M. He, "Monocular Human Pose Estimation: A Survey of Deep Learning-based Methods", Computer Vision and Image Understanding (CVIU), arXiv:2006.01423, 2020

[2] C. Zheng, W. Wu, T. Yang, S. Zhu, C. Chen, R. Liu, J. Shen, N. Kehtarnavaz, M. Shah, "Deep Learning-Based Human Pose Estimation: A Survey", unpublished, arXiv:2012.13392, 2020

[3] S. Jin, L. Xu, J. Xu, C. Wang, W. Liu, C. Qian, W. Ouyang, P. Luo, "Whole-Body Human Pose Estimation in the Wild", European Conference in Computer Vision (ECCV), arXiv:2007.11858, 2020

[4] D. Zauss, S. Kreiss, A. Alahi, "Key pointCommunities", International Conference on Computer Vision (ICCV), arXiv:2110.00988, 2021

[5] K. Sun, B. Xiao, D. Liu, J. Wang, "Deep High-Resolution Representation Learning for Human Pose Estimation", Conference on Computer Vision and Pattern Recognition (CVPR), arXiv:1902.09212, 2019

[6] N. Samet, E. Akbas, "HPRNet: Hierarchical Point Regression for Whole-Body Human Pose Estimation", unpublished, arXiv:2106.04269, 2021

[7] Z. Cao, T. Simon, S.-E. Wei, Y. Sheikh, "Realtime Multi-Person 2D Pose Estimation using Part Affinity Fields", Conference on Computer Vision and Pattern Recognition (CVPR), arXiv:1611.08050, 2017

[8] A. Bulat, J. Kossaifi, G. Tzimiropoulos, M. Pantic, "Toward Fast and Accurate Human Pose Estimation via Soft-gated Skip Connections", unpublished, arXiv:2002.11098, 2020

[9] Z. Su, M. Ye, G. Zhang, L. Dai, J. Sheng, "Cascade Feature Aggregation for Human Pose Estimation", unpublished, arXiv:1902.07837, 2019

[10] S. Yang, Z. Quan, M. Nie, W. Yang, "TransPose: Key pointLocalization via Transformer", International Conference on Computer Vision (ICCV), arXiv:2012.14214, 2021

[11] B. Artacho, A. Savakis, "UniPose: Unified Human Pose Estimation in Single Images and Videos", Conference on Computer Vision and Pattern Recognition (CVPR), arXiv:2001.08095, 2020

[12] W. Li, Z. Wang, B. Yin, Q. Peng, Y. Du, T. Xiao, G. Yu, H. Lu, Y. Wei, J. Sun, "Rethinking on Multi-Stage Networks for Human Pose Estimation", unpublished, arXiv:1901.00148, 2019

[13] H. Zhang, H. Ouyang, S. Liu, X. Qi, X. Shen, R. Yang, J. Jia, "Human Pose Estimation with Spatial Contextual Information", unpublished, arXiv:1901.01760, 2019

[14] B. Artacho, A. Savakis, "OmniPose: A Multi-Scale Framework for Multi-Person Pose Estimation", unpublished, arXiv:2103.10180, 2021

[15] X. Peng, Z. Tang, F. Yang, R. Feris, D. Metaxas, "Jointly Optimize Data Augmentation and Network Training: Adversarial Data Augmentation in Human Pose Estimation", Conference on Computer Vision and Pattern Recognition (CVPR), arXiv:1805.09707, 2018

[16] W. Yang, S. Li, W. Ouyang, H. Li, X. Wang, "Learning Feature Pyramids for Human Pose Estimation", International Conference on Computer Vision (ICCV), arXiv:1708.01101, 2017

[17] Y. Luo, J. Ren, Z. Wang, W. Sun, J. Pan, J. Liu, J. Pang, L. Lin "LSTM Pose Machines", Conference on Computer Vision and Pattern Recognition (CVPR), arXiv:1712.06316, 2018

[18] J. Song, L. Wang, L. Van Gool, O. Hilliges, "Thin-Slicing Network: A Deep Structured Model for Pose Estimation in Videos", Conference on Computer Vision and Pattern Recognition (CVPR), arXiv:1703.10898, 2017

[19] F. Zhang, X. Zhu, H. Dai, M. Ye, C. Zhu, "Distribution-Aware Coordinate Representation for Human Pose Estimation", Conference on Computer Vision and Pattern Recognition (CVPR), arXiv:1910.06278, 2020

[20] Y. Chen, Z. Wang, Y. Peng, Z. Zhang, G. Yu, J. Sun, "Cascaded Pyramid Network for Multi-Person Pose Estimation", Conference on Computer Vision and Pattern Recognition (CVPR), arXiv:1711.07319, 2018

[21] S. Kreiss, L. Bertoni, A. Alahi, "OpenPifPaf: Composite Fields for Semantic Key pointDetection and Spatio-Temporal Association", unpublished, arXiv:2103.02440, 2021

[22] M. Kocabas, M. S. Karagoz, E. Akbas, "MultiPoseNet: Fast Multi-Person Pose Estimation using Pose Residual Network", European Conference in Computer Vision (ECCV), arXiv:1807.04067, 2018

[23] O. Ronneberger, P. Fischer, T. Brox, "U-Net: Convolutional Networks for Biomedical Image Segmentation", Inrernational Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI), arXiv:1505.04597, 2015

[24] J. Wang, K. Sun, T. Cheng, B. Jiang, C. Deng, Y. Zhao, D. Liu, Y. Mu, M. Tan, X. Wang, W. Liu, B. Xiao, "Deep High-Resolution Representation Learning for Visual Recognition", in IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 43, no. 10, pp. 3349-3364, 1 Oct. 2021

[25] K. He, X. Zhang, S. Ren, J. Sun, "Deep Residual Learning for Image Recognition", unpublished, arXiv:1512.03385, 2015

[26] X. Zhang, X. Zhou, M. Lin, J. Sun, "ShuffleNet: An Extremely Efficient Convolution Neural Network for Mobile Devices", Conference on Computer Vision and Pattern Recognition (CVPR), arXiv:1707.01083, 2018

[27] N. Bodla, B. Singh, R. Chellappa, L. S. Davis, "Improving Object Detection with One Line of Code", International Conference on Computer Vision (ICCV), arXiv:1704.04503, 2017

[28] J. Wu, H. Zheng, B. Zhao, Y. Li, B. Yan, R. Liang, W. Wang, S. Zhou, G. Lin, Y. Fu, Y. Wang, Y. Wang, "AI Challenger: A Large-Scale Dataset for Going Deeper in Image Understanding", IEEE International Conference on Multimedia and Expo (ICME), arXiv:1711.06475, 2019

[29] Y. Yang, D. Ramanan, "Articulated Human Detection with Flexible Mixture-of-Parts", in IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 35, no. 12, pp. 2878-2890, Dec. 2013

[30] M. Andriluka, L. Pishchulin, P. Gehler, B. Schiele, "2D Human Pose Estimation: New Benchmark and State-of-the-Art Analysis", 2014 IEEE Conference on Computer Vision and Pattern Recognition, pp. 3686-3693, 2014

Extraction of Human Motion Parameters from Videos

[1]Felix Pîrvan, [2]Mihaela Nicolau, [3]Daniela Hagiescu
Advanced Slisys Bucharest, Romania

ABSTRACT

Motion parameters of the human body can be powerful indicators for that person's activity, psychological or emotional state. As 3D coordinates of human body parts are often hard to collect, we propose a set of methods that take as input 2D video frames from an ordinary RGB camera. While this is obviously a limitation, we devised several ways to mitigate it and consequently extract useful information from the input video. We define 9 motion parameters that describe in various ways the person's motion: expansion, fluidity, characteristic energy, vivacity, symmetry, twist, dynamism, directness and periodicity. We believe this is a step into a better understanding of human motion, and can think of several direct applications.

Keywords—*motion parameter; movement parameter; human body; human motion; body part; body joint*

I. INTRODUCTION

Estimating human motion parameters has long been a subject of interest. Previous works have addressed the task from various directions, using various input data and trying to capture as much as possible the essence of the human motion.

One of the first attempts to analyze human motion [1] met the challenge of anatomical data gathering and obtained the weight and center of gravity position for various body parts using corpses. Voluntary motion of intermediate speed was found [2] to approach the smoothest trajectory, in terms of acceleration's rate of change (jerk), being motivated by neuro-muscular considerations. The study of the voluntary arm motion coordination [3] showed that the trajectory yielding the best performance can be determined by the dynamic optimization theory and minimizes the square magnitude of the jerk. The role of gestures in the non-verbal communication process [4] is explored in relation with dance and music as ideal conveyors of expressive and emotional content. The influence of basic emotions, happiness and sadness, on a person's dance [5] revealed differences in the body motion which were captured through motion parameters. 3D motion data captured with a RGB-D sensor was used to extract motion features and parameters [6], serving for human emotion recognition.

Our contributions are the following:

- New method of 2D trajectory smoothing, aimed at reducing the square of the jerks, without using predefined intermediary points and keeping the overall trajectory shape (no curve flattening)
- Definition of 9 motion parameters, extractable from 2D coordinates: expansion, fluidity, characteristic energy, vivacity, symmetry, twist, dynamism, directness and periodicity; although a few of them have been defined before in the 3D case, we adapted those definitions to the 2D case, which is more common

II. PRELIMINARIES

We use a Web camera to capture 17 video sequences. In each video, the same person is performing a dance in a particular dance style (Ballet, Freestyler, Macarena, Lambada and others). We used a wide

variety of dance styles to be able to compare the motion parameters between them and draw conclusions about the particular features of each dance style. All videos are recorded at 30 frames per second and have 2000 frames, or roughly 66 seconds in length. To obtain the positions of the body joints, we use Open Pose [7], which is a method based on a deep neural network and has shown some of the best results for this task. It predicts 14 joints: head top, neck, shoulders, elbows, wrists, hips, knees and ankles. In fig. 1, we marked the predicted joints and the limbs obtained by connecting them.

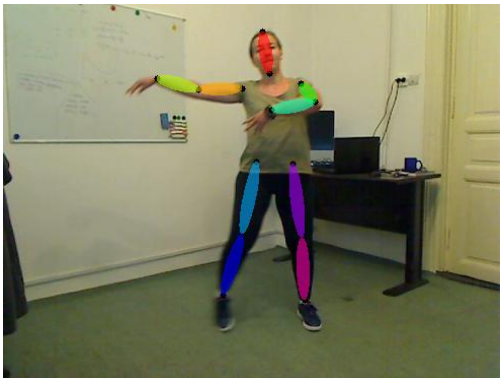


Fig. 1 Joints detected by OpenPose and limbs between them

For some images, skeleton detection can produce more than one skeleton. We are only interested in a single skeleton, so the first step is to filter out the unwanted skeletons. We first ensure that we have only one skeleton in the first frame of every video. Then for each frame with multiple skeletons, we compute the sum of distances from each joint to the corresponding joint of the skeleton in the previous frame and we keep the skeleton with the smallest sum. In other words, we keep the skeleton spatially closest to the unique skeleton in the previous frame.

III. TRAJECTORY SMOOTHING

The detection of joints faces a large array of difficult cases. Body part similarity can lead to confusion between left and right limbs. The fast motion of the person can blur the joints and therefore make the joint position unclear. Hidden joints are harder to estimate. All these cases yield perturbations in the series of joint positions.

The simplest method to smooth a data series is the moving average. This method replaces each value in the series with the average over an interval around that value. The filter Savitzky-Golay [8] is a generalization of the moving average that obtains the filter coefficients using a polynomial for a linear least squares fit of the data. Local Regresion Smoothing [9] uses locally weighted scatter plots with polynomial of first or second degree.

We smooth the joint trajectories by reducing the instantaneous acceleration. Our method is based on the actual meaning of the data. Body joints that describe the trajectories are physically constrained by the body muscles which cannot make too sharp changes in speed, so when smoothing we aim at minimizing the joint accelerations. In fig. 2, we represent a fragment from a joint trajectory. Let A, B, C, D, E be the joint positions in succesive frames. Let C', D', E' be the reflections of A with respect to B, of B with respect to C, and of C with respect to D, respectively. C', D', E' are the expected positions for C, D, E under uniform motion. In the physical interpretation, AB, BC, CD and DE are the velocities of the joint between two consecutive frames, while C'C, D'D and E'E are the accelerations of the joint in the points C, D and E respectively. In order to smooth the trajectory in the current point C, we move this point towards C', thus reducing the acceleration. This move also has the desired effects of a change in the position of D' twice as big towards D, and a change in the position of E' towards E. We continue to move C towards C', as long as the sum of squares of the accelerations decreases. If C reaches C', we stop and continue the same procedure for the next point D, taking into account the accelerations D'D, E'E and F'F.

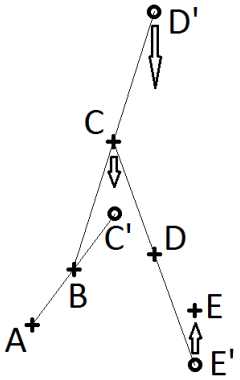


Fig. 2 Trajectory smoothing. Crosses represent joint positions, circles represent positions that would cancel the acceleration for each 3-point segment. Moving point C would change the positions of D' and E' in the desired directions, thus reducing the sum of squares of the accelerations

In fig. 3, we represented a practical example of trajectory smoothing. The series of accelerations is represented on the first row, and values obtained after smoothing, under the bars. The method gradually updates the values, in groups of 3.

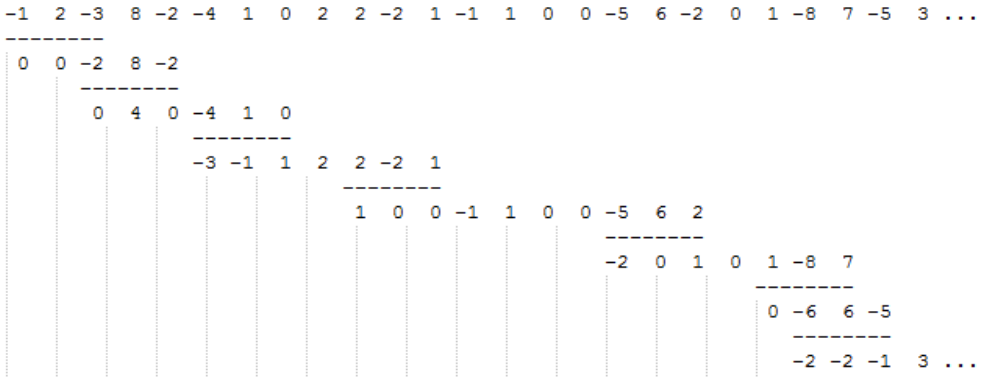


Fig. 3 Trajectory smoothing. The first row represents the successive accelerations of a joint. Below the bars, there are the smoothed accelerations. The sum of squares of all the accelerations goes down from 327 to 57, while the sum of their absolute values decreases from 67 to 25.

In fig. 4, we present a real case scenario, where the trajectory of the right wrist was smoothed. It can be seen that motion blur affects the detection, but trajectory smoothing follows more naturally the motion of the wrist.

Fig. 4 Trajectory smoothing. The detected right wrist (left side of the image) is represented by a black dot, while the smoothed trajectory positions are represented by a red dot. The dots are overlapping in the initial and final positions, while there is significant distance between them in the frames in-between.

IV. The Motion Parameters

Expansion, a parameter describing the quality of the motion, was previously defined [5] between wrists and elbows, on one hand, and the body center, on the other hand. We adapted this definition to our 2D data, also taking into account the variation of the distance between person and camera. We normalized the values obtained for the expansion and integrated them over an interval of several seconds, to cancel out the momentary variations. Let A be the wrist, B – the elbow, C – the shoulder, and D – the hip on the same side of the body. We compute the expansion as:

$$E = \frac{AD}{AB + BC + CD} \tag{1}$$

As can be deduced from the formula, the expansion takes values in [0, 1]. When the wrist touches the hip, the expansion is 0. When the arm is extended upwards and all four joints (hip, shoulder, elbow and wrist) are collinear, the expansion is 1. In order to reduce the errors due to foreshortening of limbs in the projection plane, we compute this parameter for the left side of the body, as well as for the right side, and take the expansion of the body to be the maximum of the two. In fig. 5, we represented the expansion extracted from three different dances: Ballet, Freestyler and Macarena. The graph shows that, although there is variation within each dance, the Ballet expansion is generally the highest, while the Freestyler expansion is the lowest and has the smallest variance. Also, within one dance style, there are periods of relatively constant expansion, reflecting specific dance routines. This can best be observed in the Ballet graph, which has roughly 3 such periods, the first with a high expansion, the second with lower expansion, and the third with very high expansion.

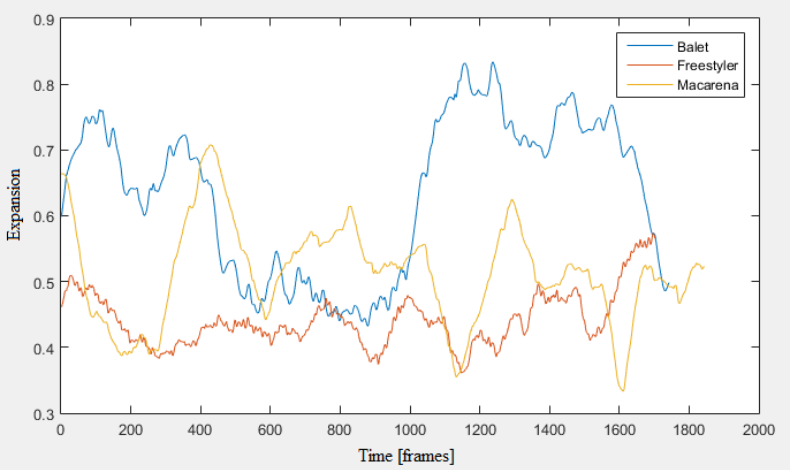


Fig. 5 The expansion of the body during three different dance styles, as a function of time. Each moment of time is a video frame.

Some motion parameters describe well a certain part of the motion. When we talk about wide gestures or a fluid motion, we mean not just spatial extent, but also temporal, i.e. the time interval (number of frames) during which that gesture (motion segment) takes place. We define the **anchors** of a motion as the points where the trajectory of a joint either stop, or perform a sudden direction change, of at least 90^0 . The motion anchors split the joint trajectory in **motion segments**, characterized by a certain motion continuity. During a motion segment, the direction can change by any amount, but not suddenly. A motion segment can have any length, defined as the number of frames between the final anchor and the initial anchor. Fig. 6 shows a joint trajectory during 16 frames and has the motion anchors painted red.

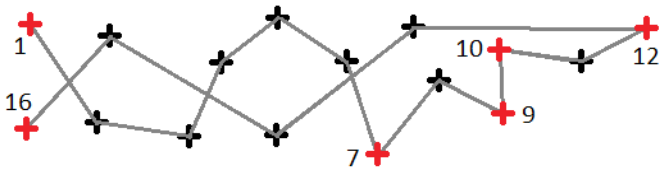


Fig. 6 The trajectory of a joint during 16 frames. The motion anchors are represented in red, defining 5 motion segments, between the frames 1-7, 7-9, 9-10, 10-12 and 12-16. Each motion anchor marks a change in direction of more than 90^0 .

A motion is fluid if it has only small instantaneous changes in acceleration, called jerks. Because the motion as a whole has inherent jerks at the anchors, we analyze the fluidity during the motion segments, as a property of each segment. For a rectilinear motion between two points, the position of intermediary points that minimize the jerk can be computed, given the initial and final velocities and accelerations are zero. [2] But for a multidimensional motion, the formula can be applied only with the additional condition that the trajectory passes through a certain point at a certain moment [3], which makes it lose its generality. In our situation, we don't have mandatory intermediary points, and without them, the trajectory that minimizes the jerk between any two points would be the straight line between them. So we cannot minimize the jerk without reducing the trajectory to a straight line.

The fluidity index was defined in [6] as the inverse of the jerk, integrated over the length of the motion segment. For the discrete case of the pixel-level trajectory, this formula yields too small values, because the smallest non-zero jerk is 1, for which it would result a fluidity index of 0.5, too small for a small jerk. Thus, we define the **fluidity** as the square root of the inverse of the average jerk of a motion segment, scaled to take values in [0, 1].

$$F = \frac{1}{\sqrt{j}+1} \tag{2}$$

It approaches zero when the jerk is very high. It is equal to 1 when the jerk is equal to 0. As the jerk depends on the joint position in 4 consecutive frames, the fluidity can only describe motion segments of length at least 3. Fig. 7 shows the average lengths of the motion segments of each joint, for three selected dance videos. The head and arm joints in the ballet video have much longer motion segments, reflecting the wider and slower gestures, especially of the upper body parts.

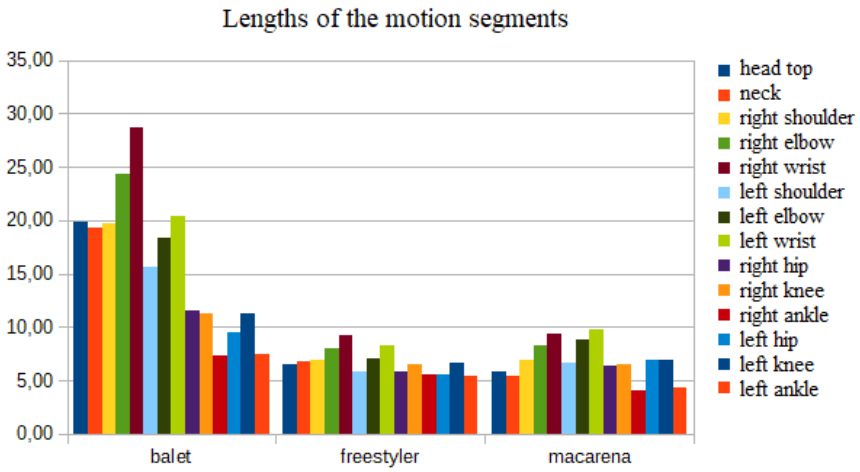


Fig. 7 Average lengths of the motion segments for three dance videos, expressed in number of frames

Fig. 8 shows the average fluidity of three dance videos. It can be seen that Ballet is the most fluid dance, while Freestyler is the least fluid. The graph also shows a relative pattern in the fluidity of the joints. The wrists are the least fluid of all joints, because they can move more freely and thus more

sudden than the other body joints, which are stronger connected and thus have more motion constraints and fewer degrees of freedom. In fact, there is a decrease in fluidity from shoulder to elbow to wrist. Also, the head top is slightly less fluid than the neck, while the lower body joints have similar fluidity during the same dance style.

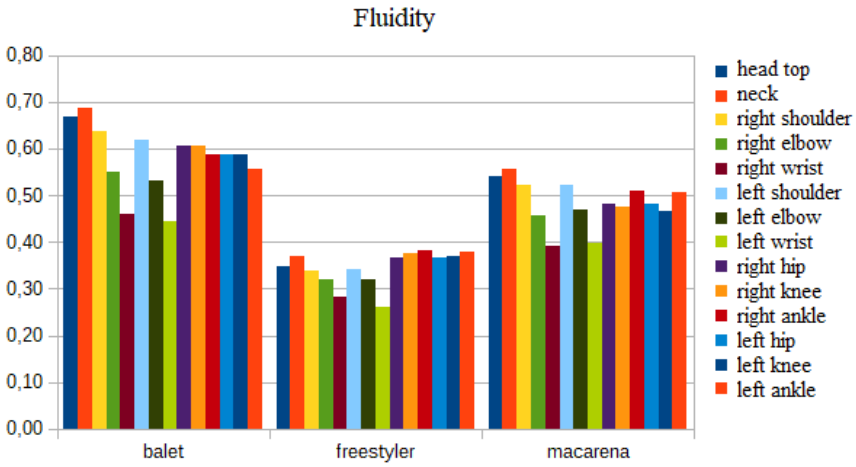


Fig. 8 Fluidity of the motion segments for three dance videos

Fig. 9 shows the fluidity as a function of the motion segment length. The analyzed joint is the right hip from the Ballet video, which has an average fluidity of about 0.6, as it can be seen in fig. 8. Each blue circle represents a motion segment. While the motion segments can vary in length from 3 to 48, shorter lengths, in the range [3, 7], are better represented than longer ones, which was expected. Also, the shorter motion segments have more fluidity variance. The red asterisks mark the average fluidity for each motion segment length. These highlight the fact that the fluidity of a certain joint in a certain dance style does not depend on the motion segment length: in this case, they are all close to 0.6, the global average.

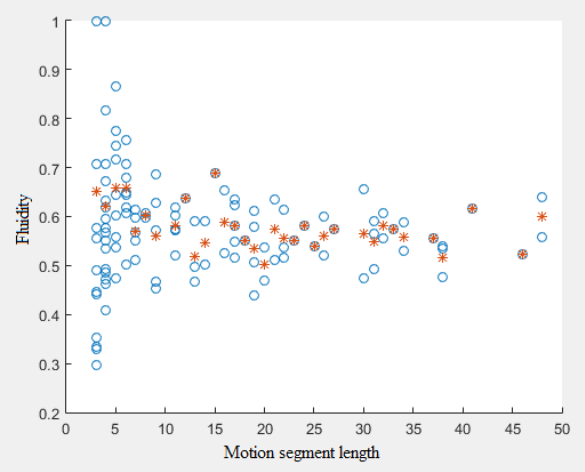


Fig. 9 Fluidity as a function of motion segment length. Each segment is represented by a blue circle, while each red asterisk represents the average fluidity of segments of the same length.

The joints define the body parts that connect them: trunk (quadrilateral defined by shoulders and hips), head, upper arms, forearms, thighs, calves. The kinetic energy of a body articulated from rigid parts is the sum of the kinetic energies of its parts. We don't know the mass of the person in question, but we can compute its **characteristic energy** (energy per mass unit). We need to know the fraction of each body part of the total body mass, as well as the position of the center of gravity of each body part relative to one of its extremities. We used the average values computed from a sample of 135 corpses

(35 males and 100 females). [1] Since we only have 2D coordinates, we are only computing the projection of the total characteristic energy on the projection plane. We use this formula for the characteristic energy:

$$\varepsilon = \frac{E}{m} = \sum_p \left(\frac{\frac{m_p}{m} * v_p^2}{2}\right) \quad (3)$$

where E – translational kinetic energy, m – body mass, p – body part, m_p – mass of the body part, v_p – velocity of the body part.

The velocity of a body part acts in its center of gravity and can be computed from the velocities of the joints at the extremities of the body part. For the trunk, we take the extreme points as the middle of the shoulder line and the middle of the hip line.

$$\vec{v}_p = \vec{v}_{p_1} + (\vec{v}_{p_2} - \vec{v}_{p_1}) * \left(\frac{G - P_1}{P_2 - P_1}\right) \quad (4)$$

where v_{p1}, v_{p2} – velocities of the body part extremities, G – position of the center of gravity of the body part, P_1, P_2 – positions of the extremities of the body part.

Similar to the characteristic energy, we compute the **vivacity** or characteristic moment (moment per mass unit). The moment of the whole body is the sum of the moments of all the component parts. Since we only have 2D coordinates, we are only computing the projection of the total vivacity on the projection plane. We use this formula for the vivacity:

$$\pi = \frac{p}{m} = \sum_i \left(\frac{m_i}{m} * v_i\right) \quad (5)$$

where p – moment, m – body mass, i – body part, m_i – mass of the body part, v_i – velocity of the body part.

The **symmetry** of the motion can be approached in several ways. To compute it relative to the section planes of the human body (frontal, sagittal and transversal), as in [6], we need the 3D joint coordinates. Of the 2D coordinates we have, the vertical coordinate is invariant to the predominant rotation of a person relative to the camera (in the horizontal plane), while the horizontal coordinate is heavily affected by this rotation. Therefore, we only take into account the vertical coordinate to compute the symmetry. A symmetric motion can be simultaneous, but it can also be alternating. For example, for an alternating raise of the hands, most of the frames contain asymmetric positions, although the motion as a whole can be considered symmetric. We define the relative height of the wrist with respect to the shoulder on the same side, as:

$$h_{rel} = \frac{\frac{y_A - y_C}{AB + BC} + 1}{2} \quad (6)$$

where A, B, C – positions of the shoulder, elbow and wrist, respectively, y_A, y_C – vertical coordinates of the shoulder and wrist (measured from the upper side of the image).

The relative height takes values in [0, 1]. When the arm hangs perfectly downwards, AB + BC = y_C - y_A, therefore h_{rel} = 0. When the arm is stretched perfectly upwards, AB + BC = y_A - y_C, therefore h_{rel} = 1. And when the whole arm is on the same horizontal with the shoulder, either stretched or flexed, y_A = y_C, therefore h_{rel} = 0.5. Integrating the left and right relative heights over several frames, to take into account the alternating motions, we obtain $H_{rel}(L)$ and $H_{rel}(R)$. The closest the integrated relative heights are, the more symmetric the motion. So we use this formula for the symmetry:

$$S = 1 - |H_{rel}(L) - H_{rel}(R)| \quad (7)$$

We compute the symmetries of the ankles in the same manner, using hips and knees instead of shoulders and elbows. Fig. 10 represents the symmetries computed for two dance styles, Ballet and Freestyler. Relative heights were integrated over 150 frames (5 seconds). The graphs show that wrist symmetry is greater for the Freestyler dance (over 92%), while the ankle symmetry is comparable for the two dance styles (over 96% in both cases). In general, ankle symmetry will always be close to 1 if both ankles stay mostly close to the ground.

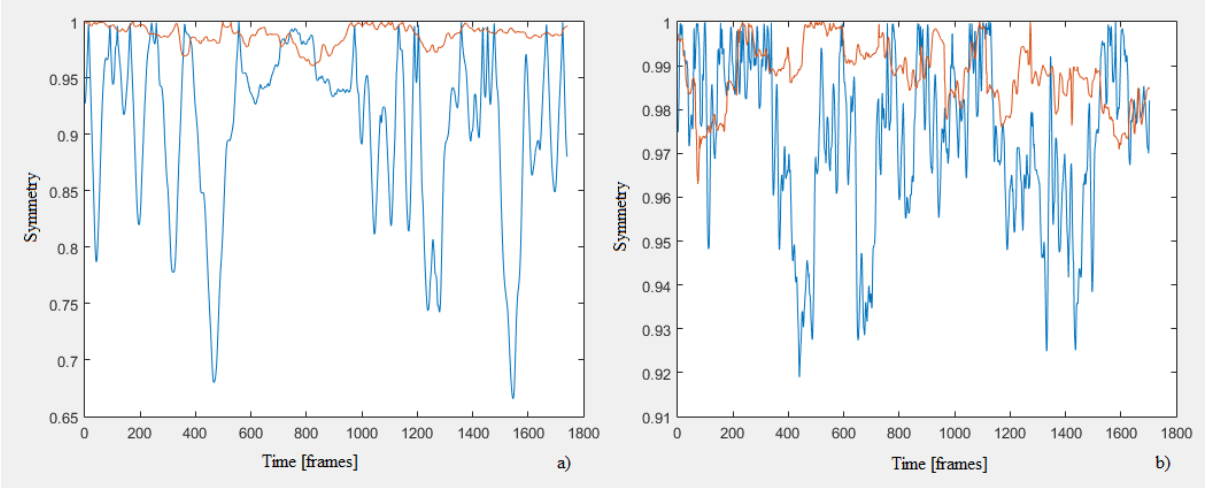


Fig. 10 Symmetries of wrists (blue) and ankles (red) computed from two dance videos, Ballet (a) and Freestyler (b). Note the different vertical scales

We define three types of tilts: head tilt relative to the trunk (in the range [0, 90] degrees), trunk tilt relative to the vertical (in the range [0, 180] degrees) and hips tilt relative to horizontal (in the range [0, 90] degrees). These parameters combined can offer hints about the overall body **twist**. The head direction is the line between the head top and the neck. The trunk is the quadrilateral defined by the shoulders and hips and its direction runs from the middle of the shoulder line to the middle of the hip line. Due to limits imposed by the 2D projection, we can only compute these values in the projection plane. Foreshortenings of the limbs on the axis person-camera can affect the tilts, the hip line being especially susceptible of abnormal high tilts when the person is viewed from the side and the horizontal hip coordinates almost coincide. Therefore, when computing the overall body twist, we weight the hips tilt by the ratio of the hip line length to the maximum hip line length over the last few seconds. With this precaution, the formula for the twist is:

$$T = (t_1 / 90 + t_2 / 180 + t_3 * d_h / D_h / 90) / 3 \quad (8)$$

where t_1, t_2, t_3 – head tilt, trunk tilt, hips tilt, respectively, d_h – distance between the hips, D_h – maximal distance between the hips over the last few seconds.

All tilts are scaled to their respective range, to bring the overall body twist in [0, 1]. A person in a upward vertical position has all the tilts equal to 0, so the twist is also 0. A person performing a complicated break dance move, with the trunk upside-down, and with the head and hips tilted at 90 degrees relative to the trunk would have all tilts equal to their respective maximal angles, and the twist equal to 1.

Often a person, during an activity (dance or other), changes her/his support leg and moves her/his center of gravity from one leg to another, passing through poses where the equilibrium is dynamic. We define the **dynamism** as the degree of instability of a certain pose. It depends on the horizontal distance between the center of gravity and the edge of the support base, as well as on distance that the free leg has to cover in order to recover the stable equilibrium. In the context of our data (2D coordinates of the body joints), we consider the ankles as the points of support. Also, the ankles will rarely have the same vertical coordinate, so almost always it will appear to be a single point of support, the lowest ankle. When, in reality, the person has both legs on the ground and the center of gravity falls

between them, the highest ankle will appear close to the height of the support ankle and therefore will have to cover only a small distance to recover the apparent stable equilibrium.

Fig. 11 shows the three possible situations that can arise with respect to the relative positions of the center of gravity (G) and the two ankles, inferior (J) and superior (S): G falls on the side of the J, G falls between J and S, G falls on the side of S. Let G' and S' be the projections of G and S on the horizontal line that passes through J.

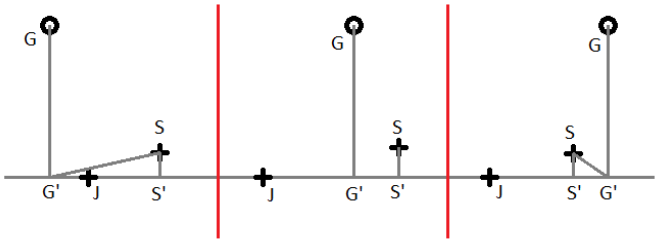


Fig. 11 The three cases that can occur with respect to the horizontal position of the center of gravity (G) relative to the inferior (J) and superior (S) ankles. G' and S' are the projections of G and S on the horizontal of J

We define the dynamism as:

$$D = \begin{cases} JG' * SS' & if\ G'\ between\ J\ and\ S' \\ JG' * SG' & otherwise \end{cases} \quad (9)$$

The case when G falls between J and S (G' is between J and S') is represented in the central panel of fig. 11 and S needs only to move to S' to reach the stable equilibrium. Otherwise, G falls outside of the segment JS' and S needs to move to G' to reestablish the stable equilibrium, as the lateral panels of fig. 11 show. If G' = S', the two branches of the formula become identical. If G' = J, then D = 0, because the center of gravity is right above the support ankle and the equilibrium is stable. If S = S' and G' between S and J, then D = 0, because the two ankles are on the same horizontal line and the center of gravity falls inside the support base.

We estimated the center of gravity based on average human data [1] for the mass of each limb relative to the total body mass and on the position of the center of gravity of each limb relative to its proximal extremity. We computed the dynamism for the dance videos Ballet, Freestyler and Macarena. Because dynamism can have very big values in case of bad joint detection, a video sequence is better described by the median of dynamism than by its mean. The results are in presented in Table I and match the intuitive observations: Macarena style is mostly static, with both feet almost always on the ground, Ballet style include legs in the air or jumps from time to time, while Freestyler dance is very dynamic, with lots of jumps from one leg to another.

TABLE I. DYNAMISM

Dance	Median Dynamism
Ballet	154
Freestyler	320
Macarena	84

For each motion segment, **directness** is the ratio between the length of the total displacement and the distance covered by the joint during that segment. [4] The formula for directness is:

$$d = sum(P_iP_{i+1}) / P_0P_n \quad (10)$$

where i – index of frame in the segment, in [0, n-1], P_i – position of joint at frame i.

Directness belongs to [0, 1]. It is equal to 0 when the segment starts and finishes in the same point and it is equal to 1 when the segment is a straight line. For example, in fig. 6, directness of the last motion segment is $(P_{12}P_{13} + P_{13}P_{14} + P_{14}P_{15} + P_{15}P_{16}) / P_{12}P_{16}$.

Periodicity was analyzed with respect to the frontal, sagittal and transversal planes, given the 3D coordinates of the joints. [6] As we only have 2D coordinates, we only take into account the vertical motion, which is invariant to the predominant rotation of a person, in the horizontal plane. In fact, almost any horizontal motion of a person implies an associated vertical motion, due to the need for a support base and to the way the body is articulated.

We compute the periodicity using the Fourier transform, whose power spectrum highlights the main frequencies of a signal. The periods can then be obtained from those main frequencies. To apply the Fourier transform on the time-series of the joint coordinates, these need to be normalized first, otherwise the maximal value of the power spectrum will correspond to the frequency zero, representing the mean of the signal values. In addition, the joint positions are harder to interpret, as they do not have a well defined range. Although constrained within the image size, the actual trajectory of a joint is hard to predict or evaluate. Instead, we use the instantaneous velocities, equivalent to the differences in position from one frame to the next. These have a natural near-zero mean, because the probability that the velocity takes positive or negative values is the same, and have a predictable distribution, as the small values are dominant and the very big outlier values can be considered detection errors. We compute periodicity for each joint, over a certain time window. The window size does not affect the outcome, as long as it is not too short to catch the short periods. However, a window too long introduces a lag in the reaction time in case of a change in periodicity over time. We found that a 5 seconds (150 frames at 30 fps) window is appropriate for most purposes. We also perform the necessary scaling to express the periodicity in beats per minute, so its formula is:

$$P = [\frac{60\,n\,i}{N}] \tag{11}$$

where n – number of frames per second, i – index of the maximal spectral density, N – number of frames of the window.

V. Conclusions adn Further Work

We computed 9 human motion parameters: expansion, fluidity, characteristic energy, vivacity, symmetry, twist, dynamism, directness and periodicity. Some of them (expansion, dynamism) are computed for each individual image, others (fluidity, directness) are computed for each motion segment, while the rest need a sequence of two or more video frames.

As different human activities are likely to be reflected in different overall motion parameters, one could discriminate between human activities based on these parameters. As we saw in our analysis, even different styles of dance can have very different motion parameters.

Motion parameters can be a good indicator of a person's psychological or emotional state. For example, big values of energy, vivacity or dynamism can suggest a good state of mind, while small values can hint to apathy or bad mood. More research is needed in this area.

By capturing the motion parameters from a dancing person, one could generate music in real-time that is more appropriate to that person's dance style. For example, the person dances slower than the music rhythm, so the music can adapt to that person rhythm. The music can also take into account the estimated emotional state of the dancing person, to match it more closely. For example, the music can become more energetic or more dynamic or more fluid, depending on those specific parameters.

Acknowledgment

The results presented in this work concerns the research carried out for the "SENTIR" research project, co-financed through the European Regional Development Fund, POC–A.1–A1.2.1–D–2015 grant,

research, development and innovation supporting economic competitiveness and the development of businesses.

REFERENCES

[1] Z. Cao, T. Simon, S.-E. Wei, Y. Sheikh, "Realtime Multi-Person 2D Pose Estimation using Part Affinity Fields", Conference on Computer Vision and Pattern Recognition (CVPR), arXiv:1611.08050, 2017

[2] A. Savitzky, M. J. E. Golay, "Smoothing and Differentiation of Data by Simplified Least Squares Procedures", in Analytical Chemistry, 36 (8), pp. 1627-1639, 1964

[3] J. Fox, S. Weisberg, "An R Companion to Applied Regression", SAGE Publications, 2018

[4] E. Van Dyck, P. J. Maes, J. Hargreaves, M. Lesaffre, M. Leman, "Expressing Induced Emotions Through Free Dance Movement", Nonverbal Behav 37, pp. 175-190, 2013

[5] N. Hogan, "An Organizing Principle for a Class of Voluntary Movements", The Journal of Neuroscience, vol. 4, no. 11, November 1984

[6] T. Flash, N. Hogan, "The Coordination of Arm Movements. An Experimentally Confirmed Mathematical Model", The Journal of Neuroscience, vol. 5, no. 7, July 1985

[7] S. Piana, A. Staglianò, F. Odone, A. Camurri, "Adaptive Body Gesture Representation for Automatic Emotion Recognition", ACM Transactions on Interactive Intelligent Systems, vol. 6, issue 1, pp. 1-31, May 2016

[8] S. Plagenhoef, F. Gaynor Evans, T. Abdelnour, "Anatomical Data for Analyzing Human Motion", Research Quarterly for Exercise and Sport, vol. 54, no. 2, 1983

[9] A. Camurri, B. Mazzarino, M. Ricchetti, R. Timmers, G. Volpe, "Multimodal Analysis fo Expressive Gesture in Music and Dance Performances", Gesture-Based Communication in Human-Computer Interaction Conference, 5th International Gesture Workshop, Genova, April 2003