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MICROBIOLOGICAL QUALITY PROFILE, PROTEIN CONTENT, AND ORGANOLEPTIC QUALITY OF NILE TILAPIA WADI, A TRADITIONAL FERMENTED FOOD FROM CENTRAL KALIMANTAN

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Abstract – Wadi is a typical traditional food derived from local wisdom value of Dayak communities in Central Kalimantan and its surroundings and potential to be regional reliable food product. This result recommended that wadi product of nile tilapia fermented under curing duration variations and 35% corn *lumu* had safe microbiological quality for consumption and the highest preference based upon the organoleptic test. The wadi product treated with different curing duration and different concentrations of *lumu* had higher TPC of bacterial colonies than that in the fresh tilapia. The nutritive value, especially protein, was found at the treatment of 25% rice *lumu*. Efforts to increase Nusantara food profile and national food security could be done through publication, particularly the nile tilapia wadi product of Central Kalimantan.

INTRODUCTION

National dish, regional cuisine or local cuisine is a typical characteristic of food habit in different groups of people worldwide, and therefore, food can be an expression of identity to show acceptance through people's experiences. Almerico (2014) defines food habit as the way human use food from how it is chosen, acquired, and distributed to who prepares, serves, and eats it. Parents are the biggest influencers in their children's diets (Walsh and Nelson, 2010). People can try different kinds of foods through sharing a meal with other people, eating out in many foreign restaurants, or when visiting the rural areas in or outside the country. Social and psychological factors have an influence on people's food habits and choices. For many years, traditional foods are important to show traditions of different cultures and regions. Therefore, there are numerous collections of traditional food recipes available from countries worldwide (Weichselbaum *et al.*, 2009).

Lambden *et al.* (2007) defines traditional food as natural and fresh, tasty, healthy and nutritious, inexpensive, and socially and culturally beneficial. Wadi is one of the fish-based local food products. Its production uses traditional fish fermentation with addition of salt, and sugar, and variation of lumu (Petrus, 2013). Lumu is food additive of wadi made of padi, rice or corn grains roasted up to be cooked in brownish color, and finely pounded (Dewi *et al.*, 2015).

There are so many fermented products, such as porridges, beverages, bread, pancakes, fermented meat, fish, vegetables, and condiments. Fermented foods and beverages are traditionally believed to have medicinal value and contribute to the livelihood of rural and periurban residents, income gain through a valuable small scale enterprise option (Marshall and Mejia, 2011). Nutritional knowledge is important to live healthy. In North Eastern Thailand, Perez *et al.* (2006) found that more than 50% of young people have accurate knowledge of the health risks of consuming energy-dense, high-

animal-fat foods that may lead to high blood pressure, heart disease, diabetes and high cholesterol, and nearly 50% of them lack enough understanding about these issues. Food knowledge can be obtained from the frequency of shared dinners, government health campaign on TV, food promotion (Walsh and Nelson, 2010), cultural practices (Perez *et al.,* 2006). Lack of knowledge and understanding about having fast foods can put people at risk of the negative health impacts (Seubsman *et al.,* 2009). Optimum nutrition contributes to health, well-being, normal development, and high quality of life. Undernutrition, over-nutrition, and malnutrition are linked to suboptimal health outcomes (Gibney *et al.,* 2009). Over-nutrition can cause obesity, particularly in both developing and food-secure countries, such as Australia, and poor diet can also cause chronic diseases, such as cardiovascular disease, Type-2 diabetes, cancer, osteoporosis and anaemia. According to Johnson *et al.* (2012) and Phillips *et al.* (2014), continued traditional food intake and increased fruit and vegetable intake have the potential to benefit the health of rural residents. Fermentation in wadi production is done for food preservation. Adding lumu, salt, and palm sugar can give more specific taste of the wadi and inhibit the growth of proteolytic bacteria (Restu, 2014; Putra, 2001; Buckle *et al,* 2013; Petrus, 2012).

The physico-chemistry, processing, preservation, and nutrition value of wadi have been studied (Petrus, 2012; Petrus *et al.,* 2013; Restu, 2014). Fish processing through fermentation has also been reported from several high fish production countries. Fish fermentation is conducted using high technology, and the product is standardized fermented food and safe for consumption (Anihouvi *et al,* 2006; Majumdar, 2010; Kose, 2010, Huda 2012, Mohamed *et al.,* 2012).

Wadi has been known by local community in Central Kalimantan, but it is not able to be regionally reliable food product. Raw materials empirically use Pangasius catfish (Pangasius sp) (Dewi *et al.,* 2017; Restu, 2011). Efforts to increase the quality of wadi as regionally reliable food product of Kalimantan are needed through research. This study was aimed at providing information on microbiological profile, protein content, and panelist's acceptance to the taste of nile tilapia wadi. This information can be used as recommendation for wadi potential development as safe and high nutritive local food product

MATERIALS AND METHODS

Processing of Nile tilapia wadi

The nile tilapia *wadi* was produced using basic materials of rice *lumu*, sticky rice lumu, and corn *lumu*. Fresh nile tilapia was cleansed and cut in ± 4 cm size. As much as 200 g of fresh tilapia was mixed with salt, sugar, and different types of *lumu* at 15%, 25%, 35% concentrations up to be homogenous and kept in glass-container with *lumu* label. Examination on total plate count (TPC) of bacterial colonies, protein, and organoleptic was done at day-7, 12, 17, and 22, respectively.

Bacterial TPC determination of wadi

Wadi sample was tested in the laboratory at interval of 5 days to know the TPC of bacterial colonies, at day-7, day-12, day-17, and day-22, respectively. As much as 10 g of nile tilapia *wadi* was aseptically inserted into an Erlenmeyer containing 90 mL of 0.1% peptone solution, shaken, then one-ml of the solution was moved into flask A, and shaken. One ml of suspension was taken from flask A, and inserted into flask B. One mL of suspension of flask B was taken and inserted into flask C, one ml of suspension of flask C inserted into flask D, then one mL of suspension of flask D was inserted into flask E, and one mL of suspension of flask E was inserted into flask F. Thus, there were suspensions obtained at the dilution level of 10^{-1}, 10^{-2}, 10^{-3}, 10^{-4}, 10^{-5},10^{-6}. From each suspension, 0.1 mL was aseptically taken and sprayed on the plate medium surface under different codes. The bacteria-containing petridisc was closed and rotated that the inoculum sprayed could evenly disperse on the plate, then incubated at 37 °C. After 48 hours, number of bacterial colonies on the plate medium were observed and counted. The selected media were those grown by 30-300 bacterial colonies, then the total plate counts of bacterial colonies in one g of *wadi* were recorded based on dilution level.

Moreover, as much as 0.1 mL of each suspension was aseptically taken and sprayed on the surface of PCA plate medium under suitable code. The plate medium-containing petri disc was covered and twirled so that the inoculum spark was evenly distributed on the surface of PCA plate medium. The culture on the PCA plate medium was incubated at 37 °C. After 48 hours, number of bacterial colonies growing on the plate medium was observed and counted. The medium grown with 30-300 colonies was selected, then the total plate count

(TPC) of the bacterial colonies in each gram of *wadi* was assessed based on dilution level.

Protein content

Measurement was conducted in nile tilapia *wadi* and fresh fish as control following Total Nitrogen method of Indonesian National Standard (SNI 01-2354.4-2006). Two g of crushed *wadi* were added with 2 catalyst tablets and several boiling stones, 15 ml of 97% H_2SO_4 and 3 mL of H_2O_2 were then slowly added and left for 10 min. in acid room. It was then destructed at 410 °C for 2 hours until the solution turned clear, and left up to room temperature, then added with 75 mL of distilled water. An Erlenmeyer containing 25 mL of 4% H_3BO_3 solution was prepared as distillate container, added with 50-70 mL of natrium hidroksida-thiosulfat, distillated, and held the distillate in the Erlenmeyer up to minimum 150 mL, so that the distillate turned to yellow color. The distillate was then titrated with standard solution of 0.2N HCl until the color turned from green to natural gray, and the number of nitrogen was determined using stoichiometry.

Organoleptic test

Wadi samples were washed from the *lumu* and fried in hot cooking oil for approximately 10 min. and prepared for the panelists. This test employed a total of 16 people, 8 males and 8 females. The examination was based on the panelist's sensory ratings and covers on color, texture, aroma, and taste.

RESULTS AND DISCUSSION

Microbiological profile of nile tilapia *wadi*

TPC determination of bacterial colonies on the nile tilapia *wadi* done at the curing time of 7 days, 12 days, 17 days, and 22 days is presented in mean TPC values (Table 1). This study found higher number of TPC in the *wadi* than that in the fresh nile tilapia, 1.8 x 10^3 colonies/g.

According to Indonesian National Standard (SNI-17388:2009), maximum limit of microbial pollutants in fresh fish is 5 x 10^5 col./g. The TPC of the fresh tilapia used as control was 1.8 × 10^3 col/g meaning that the fresh nile tilapia was still worth to be consumed. The use of all types of *lumu* made the total plate number of bacterial colonies rise starting from day-7 to day-15 of curing. The use of 35% corn *lumu* yielded *wadi* with the best microbiological quality. Curing duration of the *wadi* with corn *lumu* at day 7th to 17th had lower TPC.

Table 1. Mean TPC of bacterial colonies in nile tilapia *wadi* (colonies/g)

	Type of lumu			
	Curing duration (days)			
	7 days	12 days	17 days	22 days
P1	1.9 x 10^4	1.3 x 10^6	4.0 x 10^4	9.8 x 10^3
P2	1.5 x 10^4	9.2 x 10^5	6.2 x 10^4	1.1 x 10^4
P3	1.8 x 10^4	1.1 x 10^6	1.2 x 10^4	7.0 x 10^5
Q1	2.1 x 10^5	2.3 x 10^4	3.2 x 10^5	1.3 x 10^4
Q2	1.7 x 10^4	7.7 x 10^4	1.4 x 10^4	1.5 x 10^4
Q3	2.4 x 10^4	6.9 x 10^6	8.1 x 10^4	1.1 x 10^5
R1	9.3 x 10^3	7.9 x 10^4	5.3 x 10^4	1.7 x 10^4
R2	1.2 x 10^4	2.4 x 10^4	1.3 x 10^4	1.9 x 10^4
R3	1.8 x 10^4	1.6 x 10^5	1.4 x 10^5	6.1 x 10^4

Notes: P1 : rice lumu 15%, P2 : rice lumu 25%, P3 : rice lumu 35%; Q1: sticky rice lumu 15%, Q2: sticky rice lumu 25%, Q3: sticky rice lumu 35%; R1: corn lumu 15%, R2: corn lumu 25%, R3: corn lumu 35%.

Protein content of nile tilapia *wadi*

Table 2 demonstrates the protein content of nile tilapia *wadi* treated with different types of *lumu* at the curing duration of 7 days, 12 days, 17 days, and 22 days.

Table 2. Protein content of nile tilapia-based wadi

	Type of lumu			
	Curing duration (day)			
	7 day	12 day	17 day	22 day
P1	15.35	17.97	15.65	19.10
P2	15.22	17.71	15.84	20.54
P3	14.81	14.53	12.68	11.74
Q1	17.19	14.60	16.07	18.26
Q2	14.74	15.14	12.41	13.05
Q3	13.59	12.33	13.38	11,05
R1	16.15	15.92	15.22	18.84
R2	14.83	16.61	17.25	15.73
R3	13.63	12.59	11.73	14.92

Notes: P1 : rice lumu 15%, P2 : rice lumu 25%, P3 : rice lumu 35%; Q1: sticky rice lumu 15%, Q2: sticky rice lumu 25%, Q3: sticky rice lumu 35%; R1: corn lumu 15%, R2: corn lumu 25%, R3: corn lumu 35%

The highest protein content was recorded in the nile tilapia *wadi* with 25% rice *lumu* and 22 days of curing, and the lowest (11.05%) in the nile tilapia *wadi* with *35% sticky rice lumu*. Based on curing duration and type of *lumu* treated in nile tilapia *wadi* fermentation, it was apparent that the highest protein content be found at 7 days of curing using

15% sticky rice *lumu*. In 12 days of curing, the highest protein was recorded in the *wadi* using 15% rice *lumu*. In 17 days of curing, the highest protein content was found in the *wadi* using 25% corn *lumu*, while in 22 days of curing, the highest protein content was recorded in the *wadi* using 25% rice *lumu*. In general, the best *lumu* combination yielding the highest protein in tilapia *wadi* was found at low concentration of all types of lumu (Table 2). To obtain the best protein of the *wadi*, the curing duration should also be considered. The consumer could also choose appropriate *lumu* and curing duration with the availability of *lumu* raw materials and the daily need for consumption.

Table 2 demonstrates that mean protein content of the *wadi* is higher than that of fresh nile tilapia (Table 3) under the treatment of *lumu* type and curing duration.

Table 3. Protein, fat and carbohydrate content of fresh nile tilapia

Parameter	Nile tilapia (%)
Protein	14.92
Fat	1.71
Carbohydrate	3.75

Processing *wadi* as preserved food product basically uses fermentation (Khairina and Khotimah, 2006; Petrus, 2012). Fish fermentation was generally done using fish-carbohydrate-salt formulation (Sopandi and Wardah, 2014; Shewfelt, 2013). The present study showed that 22 days of storage with 25% rice *lumu* yielded the highest protein content, 20.54%, while the lowest protein content, 11.05%, was found in the treatment of 35% corn *lumu* and the same storage duration. The protein content of the *wadi* was higher than that of the fresh fish protein (Table 3). Based on the data above, nile tilapia *wadi* processing under treatment of 25% rice *lumu* and 22 days of curing (fermentation), in general, could increase the nutritive value of the product. It is in agreement with Petrus (2013) that in processing *wadi* from fresh climbing perch (*Anabas testudeus* Bloch), after fermentation, the *wadi* underwent protein and fat structural modification that causes it contain a number of amino acid and essential fatty acid beneficial for health. This result has informed that preservation process through fermentation with addition of *lumu* and salt could maintain the fish nutritive content.

Organoleptic quality of nile tilapia *wadi* based on texture, color, aroma, and taste

Organoleptic quality of the food product is one of the product parameters considered by the consumer. Mean scores of the organoleptic test on the nile tilapia *wadi* are presented in Table 4.

Table 4 shows that the use of 25% sticky rice *lumu* and 7 days of *wadi* storage gives the highest mean organoleptic score of 3.4. In 12 days of *wadi* storage, the administration of 25% corn *lumu* and 35% corn *lumu* gives the highest mean organoleptic score of 3.3. In 17 days of *wadi* storage, the addition of 15% sticky rice *lumu* gives the highest mean organoleptic score of 3.4. In 22 days of *wadi* storage, the treatment of 35% corn *lumu* gives the highest mean organoleptic score of 3.5. In 22 days of storage, the fermentation has reached the peak and the use of 35% corn *lumu* gives the most preferred taste to the consumers.

In *wadi* production, the use of *lumu* as fermenter could affect the quality of *wadi*. Organoleptic quality test indicated score differences among types of *lumu* used in the *wadi* for texture, color, aroma, and taste. In this case, the use of rice *lumu* gives the best effect on the texture quality, taste, color, and aroma of the nile tilapia *wadi*. Hence, rice *lumu* is the best one to use in *wadi* production. Addition of *lumu* in fish fermentation to make *wadi* could yield more typical taste of the fermented food of the *wadi* than fish preservation without addition of *lumu* (Restu,

Table 4. Mean Organoleptic test on nile tilapia wadi based on color, texture, taste, and aroma.

Nile tilapia *wadi*	Type of *lumu*									
Curing duration	P1	P2	P3	Q1	Q2	Q3	R1	R2	R3	Mean
7 days	3.3	3.2	2.8	3.1	3.4	2.6	3.1	3.1	2.7	3.1
12 days	3.1	2.9	2.9	3.1	2.9	3.1	3.0	3.3	3.3	3.1
17 days	3.2	3.2	3.3	3.4	3.1	3.3	2.9	2.9	2.7	3.2
22 days	3.2	3.4	3.2	3.0	2.9	3.1	3.0	2.7	3.5	3.1

Notes: P1: rice lumu 15%, P2: rice lumu 25%, P3: rice lumu 35%; Q1: sticky rice lumu 15%, Q2 : sticky rice lumu 25%, Q3: sticky rice lumu 35%; R1: corn lumu 15%, R2: corn lumu 25%, R3: corn lumu 35%.

2014; Putra, 2001; Dewi *et al.*, 2015). *Lumu* is one of the major materials in *wadi* production. *Lumu* and salt function as natural preservatives in *wadi* fermentation (Hermansyah and Sulistyaningrum, 2009). Salt is also main factor in *wadi* production. Addition of salt could increase the osmotic value that it could inhibit contaminant bacteria damaging the *wadi*. Salt addition in certain concentration could highly determine the organoleptic characteristics of the *wadi* as well.

CONCLUSION

Nile tilapia *wadi* traditionally fermented possessed safely consumed microbiological quality profile based upon total plate number of bacterial colonies at the curing time less than 7 days. The *wadi* treated with 25% rice *lumu* and 22 days of curing had the best nutritive value based on protein content. The preference level of the nile tilapia consumers varied based on the organoleptic quality. Addition of 35% corn *lumu* with 22 days of storage gave the best taste and the most preferred product.

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