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Sorghum Sticks (*Sorghum bicolor*) with Added Protein Source: Dumbo Catfish Meal (*Clarias gariepinus*)

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ABSTRACT

Purpose: The study aims to determine the combination of selected treatments in the proportion of sorghum flour: wheat and the amount of dumbo catfish meal and the financial feasibility of the sorghum stick business.

Design/methodology/approach: The study used a Group Randomized Design (RAK) factorial pattern with factor (P) proportion of sorghum flour: wheat (P1 = 25:75, P2 = 50:50, and P3 = 75:25) and factor (K) concentration of dumbo catfish meal (K1 = 20% and K2 = 30%), with three repeats. Observations in the study include analysis of protein, fat, water, ash, total and carbohydrate levels, yield tests, developmental tests, and organoleptic tests, including preferences for colour, aroma, taste, crispness, and texture. Data processing of protein, fat, water, ash, carbohydrate, yield, and growth values is analyzed using fingerprints (ANOVA). If there is a fundamental difference, it will be continued with the Duncan test with a confidence level of 95%. Organoleptic test data uses the Friedman test. Alternative selection is done to determine the selected treatment using the Expected Value method. The Weight test method is carried out to determine the importance of the weight of each parameter. The financial feasibility of the sorghum stick business in this study uses the BEP (Break Even Point), NPV (Net Present Value), IRR (Internal Rate of Return), and PP (Payback Period) methods.

Findings: Based on the study's results, the P1K2 treatment (proportion of sorghum flour: wheat flour 40:60 and dumbo catfish flour concentration 30%) became the selected treatment with an expectation value of 8.20. This treatment yields 74.92%, water content 12.59%, ash content 3.65%, protein content 8.99%, fat content 19.49%, carbohydrate content 55.28%, and development power 95.58%. It has a total percentage of liking for colour 96.7%, aroma 94.5%, taste 88.9%, and texture 98.9%. The results of the financial analysis of sorghum sticks are worthy of development, with BEP parameters of 20,623 packs equivalent to IDR 408,294,154.00, NPV of IDR 116,980,531.71, IRR reaching 17.79%, PP 3 years 3 months.

Research limitations/implications: This research is specifically for the development of a sorghum stick product entrepreneurial with Added Protein Source: Dumbo Catfish Meal (Clarias gariepinus)

Practical implications: The development of sorghum-based entrepreneurship products must continue to be promoted to continue to support food security

Originality/value: This paper is original

Paper type: Research paper

Keywords: *Sorghum sticks, catfish meal dumbo, Protein sources, Selected treatment, and Financial Feasibility.*

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I. INTRODUCTION

Sticks are one type of snack that people like. One of the ingredients that can be used is sorghum. As a local food ingredient, the nutritional value of sorghum contains protein (8-12%) equivalent to wheat or higher than rice (6-10%), and its fat content (2-6%) is higher than rice (0.5-1.5%). Sorghum is rich in fibre, gluten-free, antioxidants, and contains tannins(Khoddami et al. 2023).

According to the Indonesian National Standard (SNI) No. 01-2713-2000, the quality standard for stick products for protein is at least 5%. Sticks should contain enough protein apart from being a snack. One way to

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increase protein sticks is to add foods with a high protein content, including fishmeal. Fishmeal is a solid product produced by removing water and fat from fish. Fishmeal contains protein, minerals, and B vitamins; High-quality fishmeal contains 6 -10% water, 5 - 12% fat, 60 -75% protein, and 10 - 20% ash. One type of fish that can be used as a fish meal is "dumbo" catfish (Clarias gariepinus), a freshwater aquaculture fish in great demand by the public. Currently, the national production of African catfish continues to increase every year. The protein content of "dumbo" catfish per 100 g is 18.2% which is higher than the protein content of grouper at 16.97%, red snapper at 17.82%, carp at 14.61%, snakehead fish at 17.61%, and blanket squid at 16.31%. The meat will be easily damaged by the relatively high water content of "dumbo" catfish, 78.1%. Processing is needed to minimize damage, namely by processing it into flour(Ismiana, Setiyoko, and Slamet 2023).

In addition, catfish flour contains a lot of essential amino acids (amino acids that cannot be produced in the body). Processed catfish oil has a relatively good fatty acid profile because it contains 22.65% oleic (C18:1) fatty acids, 17.79% linoleic (C18:2) fatty acids, 1.21% linolenic (C18:3) fatty acids, EPA 0.57%, and DHA 3.51%. Also, fish oil from freshwater (catfish, cork, and gold) can be a source of omega-6 fatty acids. In addition, oleic fatty acids (omega 9) also provide health benefits if consumed. Seeing the many potentials of sorghum and the advantages of catfish compared to other types of fish, it is necessary to research making sticks, which aims to diversify food by substituting wheat flour with sorghum flour and adding catfish flour as a protein source to stick products (Ayundra Putri et al. 2022).

II. METHODS

This study used a factorial pattern Group Randomized Design (GRD) with a proportion factor of sorghum flour: wheat flour (P) and dumbo catfish meal concentration (K) (Pszczółkowski et al. 2023). Each level is repeated three times, and the design of this study is presented in Table 1.

Table 1. Main Research Design

Dumbo Catfish Meal Concentration (K)	*Proportion of Sorghum Flour: Wheat*		
	P1 = (40%:60%)	*P2 = (50%:50%)*	*P3 = (60%:40%)*
K1 = 20%	*P1K1*	*P2K1*	*P3K1*
K2 = 30%	*P1K2*	*P2K2*	*P3K2*

Tests are carried out to measure the quality of sticks sorghum. These tests include yield, chemical/proximate, expandability, and organoleptic tests. The resulting data will be tested statistically using SPSS 16.0 software. The data is analyzed using a variety of fingerprints (ANOVA); if there is a noticeable difference, it will be continued with the Duncan test. The Duncan test was conducted to determine the differences in each treatment with a confidence level of 95%. Organoleptic test data is non-parametric, so data processing will be calculated using Descriptive and Friedman tests. The selection of alternatives is carried out to choose the best treatment from several existing treatments. Decision-making is a process of systematically selecting the best treatment. Determination of the best / selected treatment using the Expected Value method is a weighted average of all possible outcomes where the weight is the probability value associated with each outcome (Junianto et al. 2023).

Meanwhile, to determine the importance and weight of each parameter, a Weight Test was carried out on each parameter by giving a questionnaire to the panellists. The Weight test method is carried out to determine the importance of the weight of each parameter. The financial feasibility of the sorghum stick business in this study uses the BEP (Break Even Point), NPV (Net Present Value), IRR (Internal Rate of Return), and PP (Payback Period) methods (Wulansari et al. 2023).

III. RESULTS AND DISCUSSION

The test results of yield, water content, ash content, fat content, carbohydrate content, protein content, and growing power content are presented in Figure 1-4 as follows:

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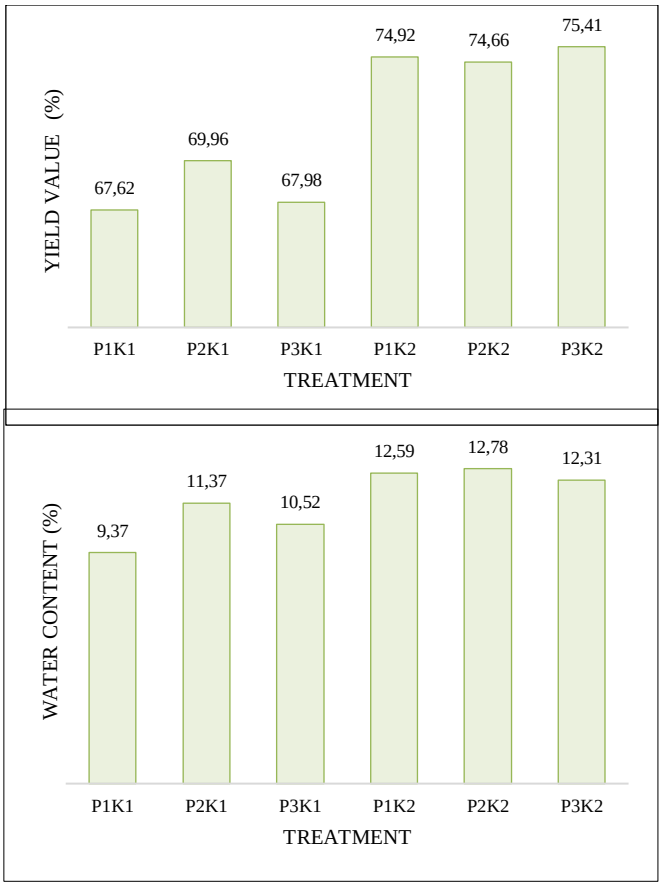

Figure 1. Sorghum Stick Yield Value and Water Content

Table 2. Duncan Test Results of Sorghum Stick

Dumbo Catfish Flour Concentration	*Yield (%)*	*Water Content (%)*
K1 (20%)	*68.52± STD (b)*	*10.42 ± STD (a)*
K2 (30%)	*75.00± STD (a)*	*12.56± STD (b)*

Description: Different notations in the same column indicate significant

Figures 1 and 1 show that the yield observations showed that there was no interaction between treatments, besides that the proportion of sorghum:wheat flour (P) had no significant effect on the yield of sorghum sticks with F count (0.129) < F table (4.10). Meanwhile, the concentration of African catfish flour (K) had a significant effect on the yield of sorghum sticks with Fcount (14.688) > Ftable (4.96), and then Duncan's test was carried out (Wulansari et al. 2023). In observing the water content, it was found that there was no interaction between treatments, besides that the proportion of sorghum:wheat flour (P) did not significantly affect the moisture content of sorghum sticks with F count (0.540) < F table (4.10). Meanwhile, the concentration of African catfish flour (K) had a significant effect on the moisture content of sorghum sticks with Fcount (6.114) > Ftable (4.96), and then Duncan's test was carried out (George et al. 2023; Yadav et al. 2023).

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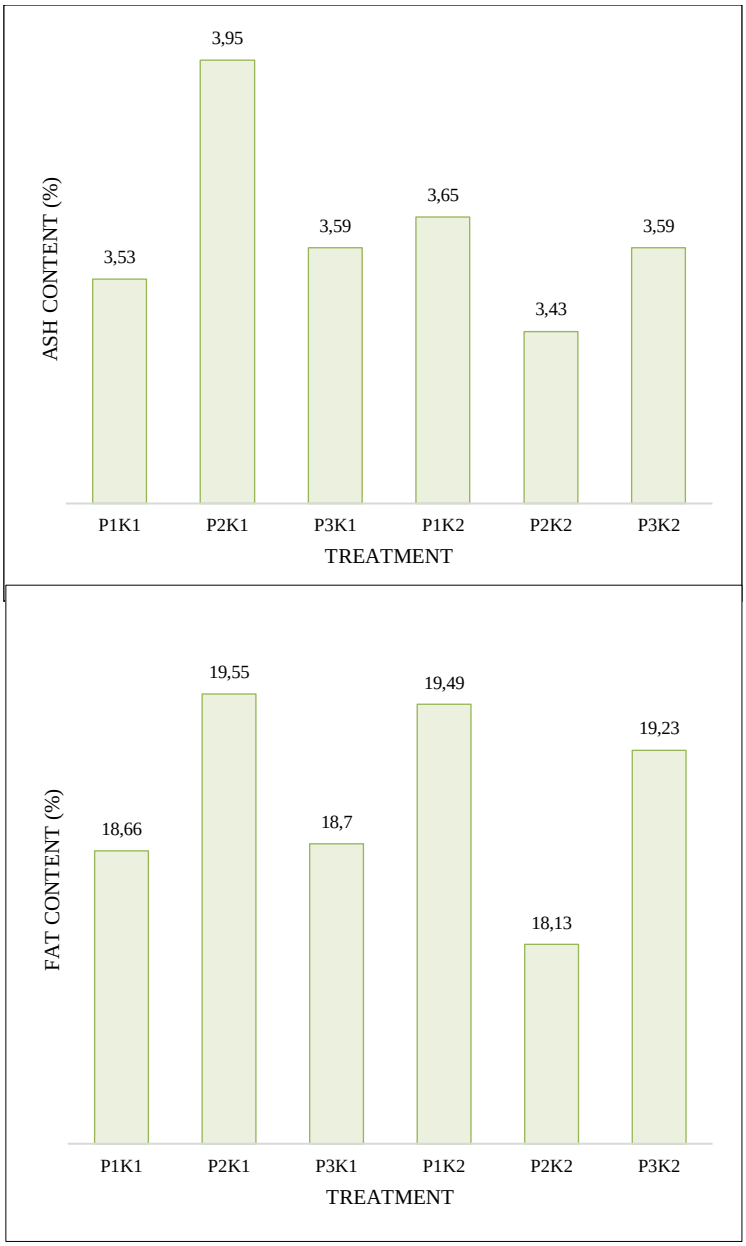

Figure 2. Sorghum Stick Ash and Fat Content

Figure 2 shows that the observation of ash content showed no interaction between treatments. Also, the proportion of sorghum: wheat flour (P) did not significantly affect the ash content with F count (0.027) < F table (4.10), and African catfish flour concentration (K) had no significant effect on the ash content of sorghum sticks with F count (0.110) < F table (4.96) (Yadav et al. 2023). Observation of fat content showed that there was no interaction between treatments. Also, the proportion of sorghum:wheat flour (P) did not significantly affect the fat content with a calculated F count (0.005) < F table (4.10), and the concentration of African catfish flour (K) had no significant effect on the fat content of sorghum sticks, with a calculated F count (0.010) < F table (4.96) (Parmar et al. 2022; Yadav et al. 2023).

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Figure 3. Sorghum Stick Protein, Carbohydrate Content, and Growing Power

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Table 2. Duncan Test Results of Sorghum Stick

Dumbo Catfish Flour Concentration	*Protein Content (%)*	*Growing Power (%)*
K1 (20%)	*6.41 ± STD (b)*	*125.94 ± STD (a)*
K2 (30%)	*8.80 ± STD (a)*	*104.03 ± STD (b)*

Description: Different notations in the same column indicate significant

Figure 3 and Table 2 show that the observed protein content showed no interaction between treatments. Besides, the proportion of sorghum flour: wheat (P) did not significantly affect the protein content of sorghum sticks. While the concentration of dumbo catfish flour (K) significantly affected the protein content of sorghum sticks with F count (2.918) < F table (4.96). The calculated F value of the proportion factor of sorghum: wheat flour (P) was shown, namely F count (6,984) > F table (4.96), and then Duncan's test was carried out (Syamsuar, Ghaffar, and Erna 2023). Observation of carbohydrate content resulted in no interaction between treatments. The sorghum:wheat flour (P) proportion did not significantly affect carbohydrate content, and the concentration of Dumbo catfish flour (K) had no significant effect on the carbohydrate content of sorghum sticks with F count (2.918) < F table (4.96). While the observation on Growing Power showed no interaction between treatments, the proportion of sorghum:wheat flour (P) did not significantly affect the growing power level of sorghum sticks. Meanwhile, the concentration of Dumbo catfish flour (K) had a significant effect on the Growing Power of sorghum sticks with F Count (6.439) > Ftable (4.96), and then Duncan's test was carried out (Afiyah and Sarbini 2021).

Table 3. Friedman Test of Organoleptic Test Sorghum Stick

Test Statistics				
	Taste	*Colour*	*Falvor*	*Texture*
N	*90*	*90*	*90*	*90*
Chi-Square	*14.931*	*43.881*	*18.070*	*53.480*
Df	*5*	*5*	*5*	*5*
Asymp. Sig.	*.011*	*.000*	*.003*	*.000*

a. Friedman Test

Table 3 shows that $\chi 2$ count (43,881) > $\chi 2$ table (11.07), then the proportion of sorghum:wheat flour and the concentration of Dumbo catfish flour have a significant effect on the colour of the sorghum sticks. There is a significant effect between the proportion of sorghum:wheat flour and the concentration of Dumbo catfish flour on the flavour of sorghum sticks, shown by $\chi 2$ count (18.070) > $\chi 2$ table (11.07). Based on $\chi 2$ count (14,931) > $\chi 2$ table (11.07), the proportion of sorghum:wheat flour and the concentration of African catfish flour significantly affect the taste of sorghum sticks. There is a significant effect between the proportion of sorghum:wheat flour and the concentration of Dumbo catfish flour on the texture of sorghum sticks, shown $\chi 2$ count (53.480) > $\chi 2$ table (11.07) (Ella, Yuwana, and Silsia 2023; Mutaqqien et al. 2023; Naimah, Ulilalbab, and Suprihartini 2023).

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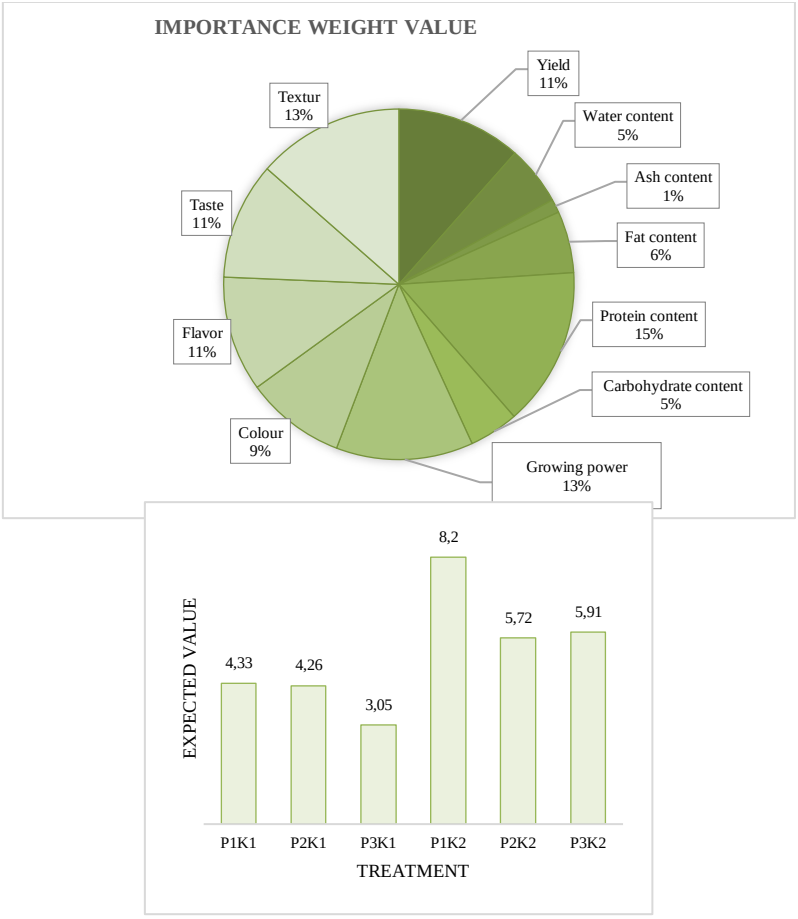

Figure 4. Sorghum Stick Importance Weight Value and Expected Value

Figure 4 shows that the highest importance of sorghum sticks is protein content, followed by texture, swelling, yield, taste, flavour, colour, fat content, moisture content, carbohydrate content, and ash content (Abreu, Lima, and Rocha 2023; Jimenez-Champi et al. 2023). Meanwhile, the highest expected value was 8.2 in the P1K2 treatment and was the chosen treatment, namely the treatment between the proportion of sorghum flour: 40:60 wheat flour and 30% dumbo catfish flour concentration. This treatment yields 74.92%, water content 12.59%, ash content 3.65%, protein content 8.99%, fat content 19.49%, carbohydrate content 55.28%, and development power 95.58%. It has a total percentage of liking for colour 96.7%, flavor 94.5%, taste 88.9%, and texture 98.9% (Errico et al. 2023; Quintieri et al. 2023; Soares Mateus et al. 2023).

The results of the financial analysis of sorghum sticks are worthy of development, with BEP parameters of 20,623 packs equivalent to IDR 408,294,154.00, NPV of IDR 116,980,531.71, IRR reaching 17.79%, PP 3 years 3 months.

IV. CONCLUSION

Based on the study's results, the P1K2 treatment (proportion of sorghum flour: wheat flour 40:60 and dumbo catfish flour concentration 30%) became the selected treatment with an expectation value of 8.20. This treatment yields 74.92%, water content 12.59%, ash content 3.65%, protein content 8.99%, fat content 19.49%, carbohydrate content 55.28%, and development power 95.58%. It has a total percentage of liking for colour 96.7%, aroma 94.5%, taste 88.9%, and texture 98.9%. The results of the financial analysis of sorghum sticks are worthy of development, with BEP parameters of 20,623 packs equivalent to IDR 408,294,154.00, NPV of IDR 116,980,531.71, IRR reaching 17.79%, PP 3 years 3 months.

REFERENCES

ISSN : 2597-4785 (ONLINE)
ISSN : 2597-4750 (PRINTED)

Abreu, Bruno, João Lima, and Ada Rocha. 2023. "Consumer Perception and Acceptability of Lupin-Derived Products: A Systematic Review." *Foods* 12(6).

Afiyah, Dyah Nurul, and Riska Nurtyanto Sarbini. 2021. "The Effect of Mocaf Substitution on Crispness and Organoleptic Quality of Milk Sticks." *Jurnal Ternak* 12(2).

Ayundra Putri, Melyani Rizky, Yuliana Arsil, Yessi Marlina, and Roziana Roziana. 2022. "Sensory Evaluation and Protein Analysis of Catfish Stick." *JPK : Jurnal Proteksi Kesehatan* 11(1).

Ella, D. S., Y. Yuwana, and D. Silsia. 2023. "Effect of Drying Method and Bad Thickness on Physical, Chemical, and Organoleptic Quality of Dry Herbal Moringa (Moringa Oleifera) Leaves." In *E3S Web of Conferences,*.

Errico, Massimiliano et al. 2023. "Brewer's Spent Grain, Coffee Grounds, Burdock, and Willow–Four Examples of Biowaste and Biomass Valorization through Advanced Green Extraction Technologies." *Foods* 12(6).

George, Sony et al. 2023. "Impact of Processing Parameters on the Quality Attributes of Spray-Dried Powders: A Review." *European Food Research and Technology* 249(2).

Ismiana, T, A Setiyoko, and A Slamet. 2023. "The Effect of Cooking Treatments and Dumbo Catfish (Clarias Gariepinus) Bone Flour Addition on the Characteristics and Sensory Evaluation of 'Geblek' Kulon Progo." *IOP Conference Series: Earth and Environmental Science* 1182(1).

Jimenez-Champi, Diana et al. 2023. "Bioactive Compounds in Potato Peels, Extraction Methods, and Their Applications in the Food Industry: A Review." *CYTA - Journal of Food* 21(1).

Junianto et al. 2023. "Processing and Sensory Quality of Dried Rebon Shrimps from the Katapang Doyong Coastal Area, Pangandaran Regency." *Asian Journal of Fisheries and Aquatic Research* 22(3).

Khoddami, Ali et al. 2023. "Sorghum in Foods: Functionality and Potential in Innovative Products." *Critical Reviews in Food Science and Nutrition* 63(9).

Mutaqqien, Hexandria Abdullah, Syarifa Ramadhani Nurbaya, Ida Agustini Saidi, and Rahmah Utami Budiandari. 2023. "Effect Of Proportion Of Flesh And Skin Of Bligo (Benincasa Hispida) On Bligo Pudding Characteristic." *Journal of Tropical Food and Agroindustrial Technology* 4(01).

Naimah, Siska Yulva, Arya Ulilalbab, and Cucuk Suprihartini. 2023. "The Effect of Proportion of Dioscorea Alata and Wheat Flour on the Acceptability of Steamed Bolu." *Journal of Tropical Food and Agroindustrial Technology* 4(01).

Parmar, Vijaya, Rajan Sharma, Savita Sharma, and Baljit Singh. 2022. "Recent Advances in Fabrication of Food Grade Oleogels: Structuring Methods, Functional Properties and Technical Feasibility in Food Products." *Journal of Food Measurement and Characterization* 16(6).

Pszczółkowski, Piotr et al. 2023. "The Use of Effective Microorganisms as a Sustainable Alternative to Improve the Quality of Potatoes in Food Processing." *Applied Sciences* 13(12).

Quintieri, Laura et al. 2023. "Alternative Protein Sources and Novel Foods: Benefits, Food Applications and Safety Issues." *Nutrients* 15(6).

Soares Mateus, Ana Rita et al. 2023. "By-Products of Dates, Cherries, Plums and Artichokes: A Source of Valuable Bioactive Compounds." *Trends in Food Science and Technology* 131.

Syamsuar, Mukhlisa A. Ghaffar, and Erna. 2023. "The Impact of Seaweed (Eucheuma Cottonii) Fortification and Frozen Storage Conditions on the Chemical Composition of Tuna (Thunnus Albacare) Sandwich." *Asian Journal of Fisheries and Aquatic Research* 22(1).

Wulansari, Angela et al. 2023. "Feasibility Analysis for The Development of Integrated Coconut Industry in Tidore Islands, North Maluku." *International Journal on Food, Agriculture and Natural Resources* 4(1).

Yadav, Virendra Kumar et al. 2023. "Transformation of Hazardous Sacred Incense Sticks Ash Waste into Less Toxic Product by Sequential Approach Prior to Their Disposal into the Water Bodies." *Environmental Science and Pollution Research* 30(28).