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Effects of Bio-Based Ingredients on the Development and Quality of Food Wrapper from Jackfruit (*Artocarpus heterophyllus* Lam.) Seed Flour

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Abstract. The use of edible food wrappers with antimicrobial properties is becoming popular nowadays. However, due to some complexities in its production and components, making it expensive, its use is often limited only to consumers who have the capacity to purchase at a relatively higher value. This can be answered by developing food wrapper using locally available bio-based ingredients known to exhibit antimicrobial properties. This study was conducted to develop food wrapper utilizing jackfruit seed flour and to assess its quality as affected by levels of malunggay leaf extract, cassava starch and garlic slurry as bio-based ingredients. Level combination of 120 % malunggay leaf extract, 80 % garlic slurry and 40 g cassava starch is the optimum level combination that satisfies the optimum formulation requirement based on product's general acceptability, production cost and nutritional value. Aroma and general acceptability of food wrapper was significantly affected by malunggay leaf extract levels and the texture acceptability of the product by cassava starch levels. The food wrapper showed no cracks when subjected to folding test and has a water and oil absorption capacity of 18.36 % and 10.76 %, respectively. It has a microbial load of 7 x 10^1 cfu/g after 35 days storage at chilling condition and bacterial pathogens (*Salmonella and E. coli*) were not detected in the product. Overall consumer preference of 81% indicates that it has a strong potential to compete as a low cost healthy alternative with the existing food wrappers in the market.

Keywords: bio-based, jackfruit seed flour, food wrapper

1. Introduction

Consumers' attitude towards bio-based food products and ingredients are in demand at present. High demand for these products is driven by the never-ending food-safety issues associated with synthetic chemical components along with environmental concerns. Furthermore, with the increase in knowledge on the benefits of bio-based ingredients, consumers nowadays are becoming more conscious on their consumption choices. Among these ingredients includes malunggay and garlic, which are known to contribute significant health benefits aside from being a natural antimicrobial agent. Cassava starch also is known to contribute in improving product quality in many food formulations.

Though varieties of product forms are already available in the market which contains bio-based ingredients, a lot of consumers, especially those seriously affected by poverty cannot access these products due to high cost. Thus, there is a need to develop food products utilizing these ingredients without the need of sophisticated equipment for processing and that production can be done at home level.

This study was conducted to maximize the use of jackfruit seeds and to utilize locally available bio-based ingredients in the development of food wrapper that can serve as a healthy alternative to existing food wrappers in the market.

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2. Methods

2.1. Procurement of raw materials

Jackfruit seeds were collected from the Department of Food Science and Technology vacuum and dehydrated jackfruit processing area for the production of jackfruit seed flour. Cassava starch was purchased from the PhilRootcrops Research and Training Center in Visayas State University, Visca, Baybay City, Leyte. All other raw materials needed including eggs, garlic, malunggay leaves and salt were purchased at Baybay City Public Market.

2.2. Variable screening

Screening of variables was conducted using Plackett-Burman Design with seven (7) input variables for eight (8) runs [2] (Gacula, 1993). Response variables include the descriptive and acceptability of the products' color, aroma, texture, pliability, taste, and general acceptability.

2.3. Experimental design for formulation optimization

A 3^3 fractional factorial design, Central Composite Design (CCD), was employed with 15 treatments for experimental combinations.

2.4. Production of bio-based food wrapper for product optimization

Filtrate from the malunggay leaves and the homogenized garlic slurry was gradually added to the previously sifted jackfruit seed flour and cassava starch in appropriate volumes. The mixture was added with constant amount of whole egg and iodized salt and was mixed thoroughly until a smooth consistency is achieved. Appropriate amount of the mixture was poured into a non-stick pan over medium heat. Doneness was determined when edges loosens from the pan and when surface looks completely dry. The final product was removed from the pan using spatula.

2.5. Sensory evaluation for product optimization

Presentation of the samples was carried out following the Incomplete Block Design (IBD) set plan 13.7 laid out by [1] Cochran and Cox (1957).

2.6. Statistical analysis and modeling

Data obtained from sensory evaluation for variable screening was analyzed using STATISTICA version 6. Data from the optimization process was subjected to Response Surface Regression (RSReg) analysis using SAS Statistical Software to determine the effects of independent variables on the sensory qualities of the product.

2.7. Verification and consumer preference test

Verification test was conducted using the optimum formulation and a treatment having level combination that falls outside the optimum region. Consumer preference test was carried out by subjecting the optimized food wrapper and a commercial counterpart to 100 randomly selected consumer panelists.

2.8. Physico-chemical and nutritional value analysis

Physico-chemical analysis includes folding test, water and oil absorption capacity and the determination of the food wrapper's nutritional value, including fat, protein, total dietary fiber and food energy value by the Regional Standards and Testing Center (RSTC), Department of Science and Technology (DOST), Lahug, Cebu City.

2.9. Microbiological analysis and shelf life determination

The microbiological quality of the food wrapper stored at chilling condition was periodically (every after seven days) examined for 35 days. A prepared vegetable for lumpia filling was wrapped using the food wrapper to assess its application. The product was stored at chilling temperature and was subjected to microbial analysis to determine its shelf life.

3. Results and Discussion

3.1. Variable screening

Based on the result of variable screening as shown in Table 1, levels of cassava starch, malunggay leaves extract and garlic slurry are the variables that significantly affect the product's quality, thus, appropriate to be used in the optimization process. These variables are believed to improve the physico-chemical, sensory, nutritional and antimicrobial property of the food wrapper.

Table 1. Statistical analysis of Plackett-Burman design expressed as effect estimates

Parameter	Parameter Estimates					
	Color	Aroma	Texture	Pliability	Taste	Gen. Accept.
Mean/Interc.	7.05357**	7.12946**	6.964286**	6.79017**	6.63839**	6.84821**
JSF	-0.26785*	0.22321*	-0.17857^{ns}	-0.29464*	-0.22321 ^{ns}	-0.37500**
CS	0.17857^{ns}	0.22321*	0.87500^{ns}	-0.09821 ^{ns}	-0.06250 ^{ns}	-0.01785 ^{ns}
MLE	0.48214**	-0.29464**	0.08928^{ns}	0.06250 ^{ns}	0.16964 ^{ns}	0.10714 ^{ns}
Garlic	0.42857**	0.72321**	0.05357^{ns}	-0.00893 ^{ns}	0.08035 ^{ns}	0.07143 ^{ns}
Whole Egg	-0.46428**	0.13392^{ns}	-0.03571^{ns}	-0.06250 ^{ns}	0.18750 ^{ns}	0.14285 ^{ns}
Salt	0.01785^{ns}	-0.09821^{ns}	-0.21429*	-0.06250 ^{ns}	-0.04464 ^{ns}	-0.03571 ^{ns}

JSF (jackfruit seed flour) MLE (malunggay leaves extract) CS (cassava starch) GS (garlic slurry)
*significant (p<0.05) ** significant (p<0.01) ^{ns} not significant

3.2. Sensory qualities of the food wrapper

Statistical analysis (Table 2) revealed that malunggay leaves extract affects the product's aroma and general acceptability. Texture acceptability is significantly affected by cassava starch level.

Table 2. Parameter estimates for the response of sensory acceptability of the food wrapper

Parameter	Parameter Estimates					
	Color	Aroma	Texture	Pliability	Taste	Gen. Accept.
MLE	-0.04875^{ns}	-0.13295**	-0.00681^{ns}	-0.09089^{ns}	-0.08092^{ns}	-0.11482*
CS	0.04643^{ns}	-0.01696 ^{ns}	-0.08110^{ns}	0.00366 ^{ns}	-0.05164^{ns}	0.02786^{ns}
GS	-0.21024^{ns}	-0.03744 ^{ns}	0.24319^{ns}	0.09875^{ns}	0.17915^{ns}	0.21220^{ns}
MLE*MLE	0.00034^{ns}	0.00064^{ns}	0.00027^{ns}	0.00040^{ns}	0.00056 ^{ns}	0.00099**
CS*MLE	0.00004^{ns}	0.00016 ^{ns}	-0.00021^{ns}	0.00009^{ns}	0.00010 ^{ns}	-0.00001^{ns}
CS*CS	-0.00010^{ns}	-0.00012^{ns}	0.00064*	-0.00004^{ns}	0.00034 ^{ns}	-0.00012^{ns}
GS*MLE	0.00009^{ns}	0.00062^{ns}	-0.00016 ^{ns}	0.00054^{ns}	0.00011^{ns}	-0.00007^{ns}
GS*CS	-0.00054^{ns}	0.00031^{ns}	0.00020 ^{ns}	-0.00004^{ns}	0.00002^{ns}	-0.00025^{ns}
GS*GS	0.00173^{ns}	-0.00012^{ns}	-0.00175 ^{ns}	-0.00089^{ns}	-0.00133^{ns}	-0.00137^{ns}

MLE (malunggay leaves extract) CS (cassava starch) GS (garlic slurry)
*significant (p<0.05) ** significant (p<0.01) ^{ns} not significant

3.3. Optimum formulation

Superimposed contour plots (Figure 1) showed that higher product acceptability is obtained at low level of cassava starch. Thus, a 40 grams cassava starch is used for the optimum formulation. Since the optimum shaded region for garlic is located within the set levels of the variables except at the region about 62.9-68.7%, a percentage level of 80% (64ml) garlic is used in the optimum formulation. This value maximizes the use of garlic and its contribution in enhancing the nutritional value of the product in addition to being a natural antimicrobial agent. To maximize also the use of malunggay leaves extract, a level beyond the set maximum value (beyond 80%) is used in the optimum formulation since product acceptability increases at levels below and beyond the set minimum and maximum values respectively. It is wise to utilize the high level of malunggay leaves extract in order also to enhance the nutritional value of the product. Thus, a level of 120% malunggay leaves extract is used in the optimum formulation.

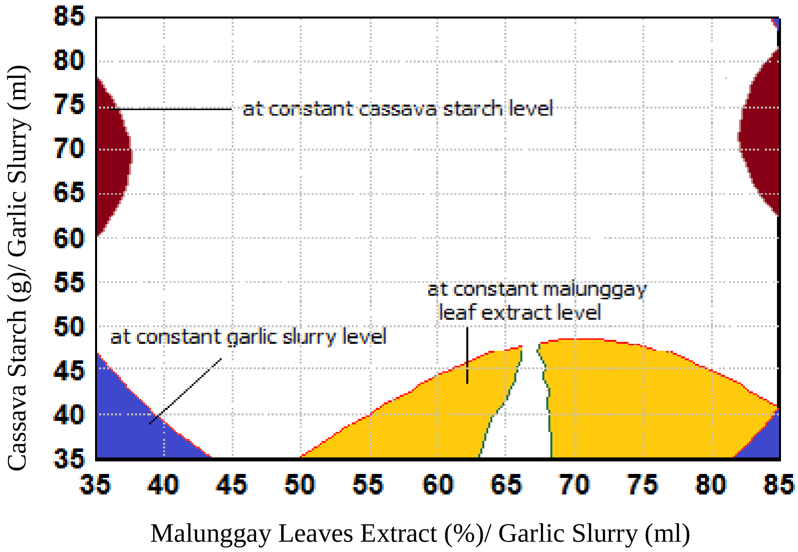

Fig. 1: Superimposed contour plots showing the optimum region

3.4. Verification and consumer preference test

T-test analysis comparing the predicted and observed values (Table 3) showed that the observed sensory acceptability rating of the optimum formulation is significantly different from the predicted values. This, however, does not imply that the predicted values are not dependable but only shows that the level combination of variables used in the optimum formulation is the most acceptable as indicated by the increase in the sensory acceptability rating range from 7.28- 8.00 ("like moderately" to "like very much") based on the 9-point hedonic scale.

Table 3. T-test results for comparing predicted and observed sensory acceptability of the optimum treatment and treatment outside the optimum region (Treatment 7)

Parameter	Optimum Formulation			Treatment 7		
	Sensory Acceptability			Sensory Acceptability		
	Predicted	Observed	Prob > |T|	Predicted	Observed	Prob > |T|
Color	7.48	8	0.00353**	6.6466	6.5357	0.25809^{ns}
Aroma	7.23	7.8214	0.00002**	6.6749	6.7143	0.73095^{ns}
Texture	7.21	7.5357	0.03861*	6.5891	6.1071	0.00092**
Pliability	6.63	7.6429	0.00002**	6.4771	6.0714	0.00143**
Taste	6.92	7.2857	0.01728*	5.92148	5.5714	0.04450**
Gen. Accept.	7.04	7.8214	0.00000**	6.6351	6.25	0.00171**

N=28 *significant (p< 0.05) **significant (p< 0.01) ^{ns} not significant

Range of scores: 9-like extremely, 8-like very much, 7-like moderately, 6-like slightly, 5-neither like nor dislike, 4- dislike slightly, 3-dislike moderately, 2-dislike very much, 1-dislike extremely

The higher overall preference of the bio-based food wrapper (81%) than the commercial counterpart (19%) implies that the biobased food wrapper form jackfruit seed flour has great market potential and a healthy alternative to existing food wrappers that are commonly used especially in home cooking. It is also an ideal channel to introduce vegetable (the malunggay leaf) and spice (garlic) to individuals who do not usually consume it.

3.5. Physico-chemical properties

The negative result of the folding test for the occurrence of cracks or any mechanical damage implies that pliability of the food wrapper in its optimum formulation is efficient enough to serve its purpose and to function well in wrapping foods.

Result in water and oil absorption evaluation revealed that the food wrapper had the capacity to absorb 18.36% and 10.76% water and oil respectively. With this amount of water absorbed, the food wrapper remains intact but its efficiency in wrapping decreases because texture and pliability are negatively affected.

3.6. Nutritional value

Result of nutritional quality analysis showed that the food wrapper contains an appreciable amount of fat (0.647%), protein (4. 36%), total dietary fiber (2.27%), total carbohydrates (34.1%) and food energy value of 160 kcal/100g. This indicates that the food wrapper can serve as a healthy alternative to existing food wrappers in the market.

3.7. Microbiological analysis and shelf-life study

Result in the microbiological analysis revealed that the food wrapper had $7x10^1$ microbial count expressed as colony-forming units per gram of sample (cfu/ g) after 35 days of storage at chilling condition. The result indicates that the microbial load of the product is low and is within the set guideline level of $\leq 10^4$ and $\leq 10^6$ for determining the microbiological quality of ready-to-eat food [3] (NSW Food Authority, 2009). The microbial quality status of the product can be attributed to several factors, including the composition of the food product having garlic and malunggay leaves extract, which are known to exhibit antimicrobial activity, its storage condition, and most importantly the good manufacturing practices applied during the process.

Result of pathogen test revealed that the bio-based food wrapper was free from pathogens, specifically *Salmonella* and *E. coli*. This implies that the bio-based food wrapper is safe for consumption, and that it does not pose a risk for any possible food borne illness caused by these pathogens.

4. Acknowledgements

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5. References

[1] W. G. Cochran and G.M. Cox. Experimental Designs. Second Edition. New York. 1957, p. 163.

[2] M.C. Gacula, 1993. Design and Analysis of Sensory Optimization. Food and Nutrition Press, Trumbull, Connecticut, USA. pp. 133- 137.

[3] NSW Food Authority. Microbiological quality guide for ready-to-eat foods: a guide to interpreting microbiological results. 2009. Retrieved September 12, 2009 from, http://www.foodauthority.nsw.gov.au/_Documents/science/microbiological_quality_guide_for_RTE_food.pdf.