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The Effect Of Fermentation On Adsorption Isotherm Corn Flour And Corn Crackers

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Abstract: Fermentation is one of the food material processing techniques to improve the nutritional value of a product. The purpose of this study was to examine the effect of fermentation on isotherm sorption in corn flour and corn crackers. The varieties of corn used were BISI 2 and POP obtained from Cereal Crops Research Institute of Sulawesi Selatan. Steps involved in this study include flouring, fermentation, analysis of nutrient content and isothermic sorption at 30°C and 40°C with humidity of 50%, 60%, 70%, and 80%. The results showed that the fermentation of all corn flours can improve nutritional value which were observed in both corn varieties. Likewise, isothermic sorption with type II (sigmoid) on all types of corn were observed (fermented and unfermented) in corn flour and corn crackers. Based on the volume of water absorbed during the storage process, it appeared that there was an effect of the fermentation on corn flour either at a temperature of 30°C or 40°C, particularly humidity at humidity of <60%. Whereas, the fermentation treatment on corn crackers showed a positive influence at the storage temperature of 30°C in all corn varieties. At storage temperature of 40°C, fermentation treatment affect only the BISI 2 varieties.

Keywords: Fermentation, adsorption, isotherm, corn flour, corn crackers

INTRODUCTION

Fermentation is one the widely used techniques in food industry. Many fermentation techniques have been tested on food materials with the aim to find the fermentation technique that is applicable to produce a product with desired characteristics [1-6]. Fermentation can be applied on corn flour, with the resulting nutritional improvements, particularly for the protein and essential amino acids lysine that far has a low level in corn [3, 7]. One of the most important parameters in the application of fermentation treatment to corn flour is the ability of the flour to absorb water during storage. Isothermic sorption of a food material is unique because it is affected by many factors including the humidity and storage temperature. Many authors have reported isothermic sorption in various corn powder by observing the humidity and storage temperature parameters [8-11]. Given the importance of isothermic sorption application in food materials, the subject of this study was to examine the sorption capability of fermented corn flour compared to unfermented control using four mathematic models to predict the sorption capability.

The fermentation method followed Amankwah, [14] Selection of seed corn. The selected seed corn is whole, free from mold and other impurities, penyosohan corn kernels off the skin and body, soaking for 24 hours, milling, fermentation 2 days, drying, milling

Obtaining The Adsorption Isotherms Of Corn Flour
The sorption capability of corn flour was observed based on Chisté, Silva [9] by placing 2 g of fermented and unfermented corn flour samples on chamber at 30°C and 40°C with humidity of 50%, 60%, 70%, and 80%. The samples were observed on daily basis until reached equivalent water level.

MATERIAL AND METHOD

Sample

Corn samples of BISI 2 and Pop varieties were obtained from Cereal Crops Research Institute of Sulawesi Selatan. The milling process of the corns followed Bolade [12, 13] The selected corn grains are intact, free from fungus and other dirt. The milling process was done by first detaching the peel and embryo, immersed for 24 hours, hulled, dried, and sieved.

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Table 1. Comparison of Nutritional Value of Corn, Corn Flour, Corn Flour Fermentation Results

No	Type of corn	Carbohydrate (%)	Protein (%)	Fat (%)	Water (%)	Ash (%)	amylose (%)	Starch (%)
1	BISI 2	68.195	7.995	1.750	14.000	1.280	5.390	60.870
2	BISI2 flour	70.995	7.740	0.330	16.336	0.250	17.345	73.810
3	Bisi 2 fermented	70.165	9.730	0.199	13.618	0.170	15.145	69.470
4	POP	67.075	9.960	2.515	10.546	1.240	6.910	56.860
5	POP flour	72.205	8.115	0.740	10.630	0.345	18.430	75.120
6	POP fermented	70.290	8.035	0.117	14.025	0.200	11.310	74.305

RESULT AND DISCUSSION

Nutrient Content

Table 1 indicates that the most abundant nutrient contained in corn is carbohydrate, either in processed or unprocessed corns with milling and fermentation. In addition, Table 1 shows that in all observed corn types, there is an increase in carbohydrate and amylose level from corn grain to corn flour, which was then decreased from corn flour to fermented corn flour. Each of the treatment applied to a food material will influence the nutritional content including starch, protein and fat [15]. Whereas, the decreased carbohydrate and amylose levels in flour after fermentation was due to the fermented starch that will degrade into sugar, thus increasing its sugar content and decreasing starch level [16]. In contrast, the protein level of BISI 2 variety decreased from corn grain to corn flour and there was an increase in protein level from corn flour to fermented corn flour. For POP variety, there was a decrease in protein level from corn grains to corn flour and then to fermented corn flour. The same trend was observed for fat level, which was decreased from grain to flour and then to fermented flour, either for BISI 2 or POP variety. The ash content also decreased from grain to flour and then to fermented flour. Basically, all the treatments will have influence on the nutritional content of the food materials. The changes resulted includes increase or decrease in nutrient elements, depending on the processing condition and structures of each the processed food materials [17-20]. However, studies reported that fermentation will increase the protein level [7, 21] and will increase the solubility and palatability of protein. In addition, the fermentation process in corn will also increase the minerals concentration [22]

Sorption Isotherms of Corn Flour

Isothermic sorption of corn flour is shown in Table 2 and 3 and Figure 1 and 2. Adsorption type indicated in Figure 2 and 3 can be classified into type II (sigmoid) at two

temperatures (30°C and 40°C). This type is suggested to be possessed by general crop such as corn, potato, and wheat starches (dried peas, soya beans, dehydrated carrots, onions and tomatoes, Brazilian nut, cashew and pistachio kernels) according to the data reported by Yannitois and Blahovec (2009) in Chiste [9]

Table 2. Corn flour adsorption at 30°C

Humidity (%)	Equivalent water content (% db)			
	BISI 2	POP	BISI 2 fermented	POP fermented
50	8.84	9.09	9.07	8.42
60	9.41	9.04	9.09	10.35
70	11.39	10.49	11.05	11.04977647
80	11.07	9.79	11.30	10.49801762

Table 3. Corn flour adsorption at 40°C

Humidity (%)	Equivalent water content (% db)			
	BISI 2	POP	BISI 2 fermented	POP fermented
50	8.25	8.47	8.11	8.43
60	8.79	8.90	8.56	8.81
70	11.24	11.60	13.23	14.7036
80	9.42	9.71	12.12	12.3909

In the table 2 and 3 above, it can be seen that the volume of water absorbed at 40°C is smaller than those at 30°C. Hydrophilic bonds in corn flour will be broken in bigger number at higher temperature. However, at the temperature it was observed that the higher the humidity level the more the water absorbed by the corn flour, either in the fermented or unfermented corn flour. This is due to the fact that the higher the storage humidity, the bigger the chance for the flour to bind to the water. The influence of fermentation treatment on isothermic absorption of corn flour involved the decreased trend in water absorption for the observed two corn varieties in each of the humidity level 50% and 60% and increased water absorption at humidity level of 70% and 80%. Therefore, the fermented corn flour is better stored at humidity of <60%.

Isothermic sorption of corn crackers

Isothermic adsorption for corn crackers is indicated in the above Table 4 and 5. Whereas Figure 3 and 4 indicates the type II adsorption. Therefore, the adsorption type of the fermented and unfermented corn flour indicated sigmoid type. The water content absorbed at 40°C tended to be higher compared to those at 30°C, even though with uneven distribution in all observed humidity levels. This indicates that the hydrophilic bonds in crackers became irregular due to high fat content as a result of frying process. Therefore, the formed bonds in crackers are hydrophobic bonds which are more readily to break at higher temperature [8] Despite these, the water content continue to increase with increased humidity percentage in the storage of com crackers, either at 30°C or 40°C.

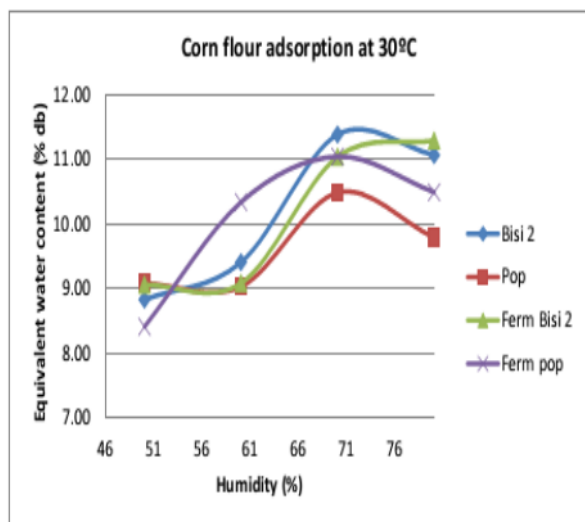


Figure 1. Corn flour adsorption at 30°C

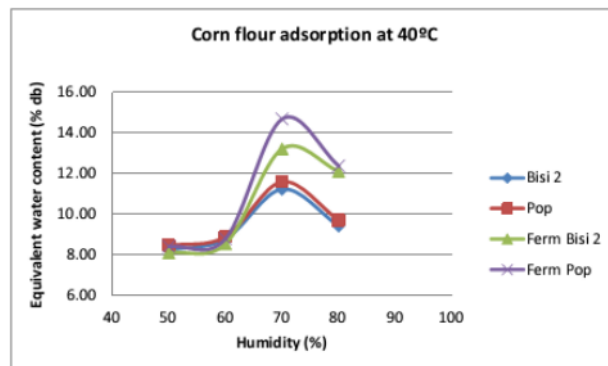


Figure 2. Corn flour adsorption at 40°C

In addition, Table 4 and 5 indicates that fermentation treatment is capable of decreasing the absorption capability of water in each of humidity level at storage temperature of 30°C for all corn varieties. At storage temperature of 40°C, the fermentation had only influence on BISI 2 variety. Therefore, the storage of corn crackers of fermented corn flour from BISI 2 and POP varieties is suggested at humidity of <60% and temperature of 30°C.

Tabel 4. Corn crackers adsorption at 30°C

Humidity (%)	Equivalent water content (% db)			
	BISI 2	POP	BISI 2 fermented	POP fermented
50	3.88	3.54	2.91	4.19
60	4.72	5.23	4.92	4.66
70	6.67	6.80	6.10	6.177001318
80	4.82	4.54	4.08	4.08

Tabel 5. Corn crackers adsorption at 40°C

Humidity (%)	Equivalent water content (% db)			
	BISI 2	POP	BISI 2 fermented	BISI 2 fermented
50	4.81	3.77	4.36	3.71
60	4.83	3.85	4.70	4.08
70	5.16	4.46	4.83	4.50725
80	4.97836	4.42524	4.44947	4.48267

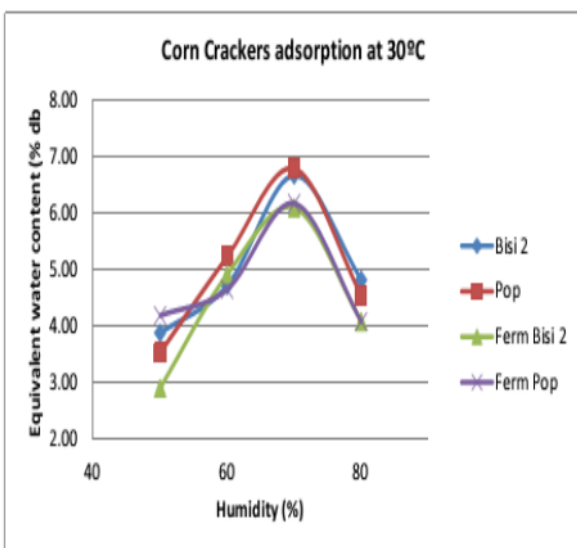


Figure 3. Corn crackers adsorption at 30°C

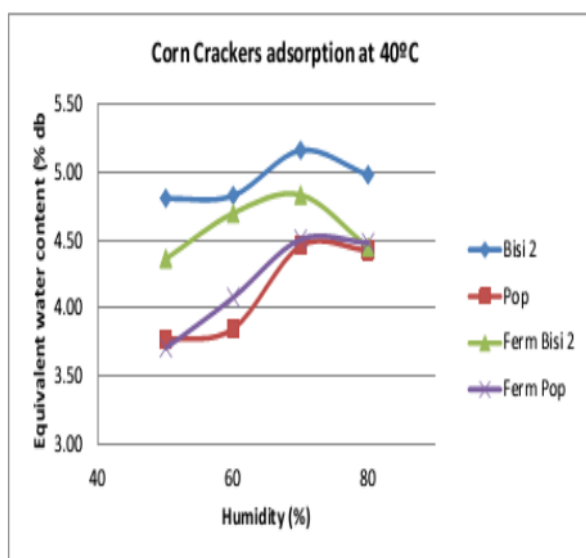


Figure 4. Corn crackers adsorption at 40°C

CONCLUSION

Fermentation process in all observed corn types could increase the nutrient content of corn flour. The same was true for isothermic sorption which indicated type II isothermic sorption (sigmoid) in all observed corn types, fermented or non-fermented, flour or crackers. According to the volume of absorbed water during storage, it was observed that fermentation treatment influenced corn flour either at 30°C or 40°C, particularly at humidity of <60%. Whereas, the fermentation treatment for corn cracker indicates positive influence at 30°C in all corn types. And at storage temperature of 40°C, fermentation treatment had influence only on BISI 2 variety.

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