The influence of chemical methods (acid modification) on elephant foot yam flour to improve physical and chemical quality on processed food

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The Influence of Chemical Methods (Acid Modification) on Elephant Foot Yam Flour to Improve Physical and Chemical Quality on Processed Food

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Abstract. This study was aimed at improving the physicochemical quality of elephant foot yam flour in Gunungpati, Semarang by acid modification. The utilization of elephant foot yam flour in several processed food was also discussed in this study. The flour of the experimental result discussed in this study was expected to become a reference for the manufacturers of elephant foot yam flour and its processed food in Gunungpati. This study modified the elephant foot yam flour using acid modification method. The physical and chemical quality of each elephant foot yam flour of the experimental result sample were assessed using proximate analysis. The resulting tuber flour weighed 50 grams and the soaked in acid solution with various concentrations 5 %, 10 % and 15 % with soaking duration 30, 60 and 90 minutes at temperature 35 ° C. The resulting suspension was washed 3 times, filtered and then dried by cabinet dryer using 46 ° C for 2 days. The dried flour was sifted with a 80 mesh sieve. Chemical test was conducted after elephant foot yam was acid modification to determine changes in the quality flour: test levels of protein, fat, crude fiber content, moisture content, ash content and starch content. In addition, color tests and granular test on elephant foot yam flour were also conducted. The acid modification as chemical treatment on elephant foot yam flour in this study was able to change the functional properties of elephant foot yam flour towards a better processing characterized by a brighter color (L = 80, a = 8 and b = 12), the hydrolysis of polysaccharides flour into shorter chain (flour content decreased to 72%), the expansion of granules in elephant foot yam resulting in a process – ready flour, and better monolayer water content of 11%. The content of protein and fiber on the elephant foot yam flour also can be maintained at a level of 8% and 1.9% levels.

FOREWORD

Elephant foot yam flour is a elephant foot yam tuber-based processed food material which is used for the sake of food diversification. The processing of elephant foot yam tuber into flour can add the value of elephant foot yam tuber and also can extend the life shelf of the elephant foot yam tuber itself[1]**.** Research conducted by[2]**,** elephant foot yam flour possesses chemical content such as 5.23% of fiber, while carbohydrate content of elephant foot yam flour is up to 83.18%

According to[3]**,** elephant foot yam flour also has turbid white color (brownish or grayish), which by using flour that has low degree of white in food products, it will affect the visual of the final product and lessen the consumer's acceptance. In the making process of flour made of tubers, color is one of the favorite parameters which is very important in determining the quality and character of the resulting flour products[4]**.**

A study conducted by[5] states that elephant foot yam flour can be used as one way to diverse local food. However, aside from the advantages existed in elephant foot yam flour, there is a weakness that limits the utilization of elephant foot yam flour as food ingredient, thus there is a need to improve the quality of elephant foot yam flour.

However, the weak points of elephant foot yam flour made by Gunungpati is that the color is blackish, and it cause itchiness if processed into food. Although it has been developed into flour, some weaknesses of elephant foot yam tuber flour's functional nature are still found which resulted in the low quality of the resulting flour. Therefore, the effort to improve the quality of the elephant foot yam tuber flour needs to be done, which one of them is by modifying the functional nature by using chemical purification method that is acid modification.

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METHOD

Material used in this research is elephant foot yam flour obtained from elephant foot yam flour production plant in Plalangan Village, Gunungpati District, Semarang, which has been sieved with mesh 40 and aquades. Modification of elephant foot yam tuber flour is carried out by using acid modification chemical purification method.

Acid-modified flour is prepared by hydrolyzing the starch contained in the flour using an acid under gelatinization temperature, that is, at a temperature of about 52° C. The basic reactions include α-1,4-glycosidic cutting from α-1,6-D-glycosidic amylose from amylopectin, so the size of the starch molecule becomes lower and it increases the tendency of the paste to form a gel.

Acquired elephant foot yam tuber flour is weighed 50 grams and it is then soaked in acetic acid solution with various concentration (A1: 5%; A2: 10%; A3: 15%) and reaction time (B1: 30 minutes; B2: 60 minutes; B3: 90 minutes) at 35 ° C. The suspense slices or deposits were washed 3 times and filtered and then dried by a cabinet dryer using 46º C for 2 days. Afterwards, it is mashed and sieved with a size of 80 mesh.

The product (flour) with chemical purification obtained's functional properties will be studied. Observations were also made on unmodified flour (control), so that the flour's natures were comparable. Chemical analysis on the flour include content of water, ash, starch, fiber[6], amylose (IRRI method). The water content of the flour was analyzed at 105° C until it reached constant weight. Ash content was analyzed by spraying in kiln, heating at temperature of 500-600 ºC for 6 hours. Determination of fat content is done by using Soxhlet method. Color testing used CIE L * a * b method. Meanwhile observation on flour granule character used photo microscope.

RESULT AND DISCUSSION

Based on the test result of water content in elephant foot yam flour which has acid modification and control treatment, it is known that elephant foot yam flour with acid modification treatment is able to bind water better (8-11%) than the control of elephant foot yam flour (7%). It is suspected because acid modification treatment can degrade some of the elephant foot yam starch into simpler sugars so that the water binding ability is better. While the starch level of control elephant foot yam flour is 69%, the starch level of elephant foot yam flour with acid modification treatment is in the range of 72 - 79%. It is suspected that elephant foot yam flour with acid modification treatment has sweeter taste and shorter polysaccharide chain than elephant foot yam flour without acid modification treatment (control) (Table 1.)

TABLE 1. Chemical Test Result of Experimental and Control Elephant Foot Yam Flour

Sample	**Parameter**					
	Water Content (%)	Ash Content (%)	Fat (%)	Protein (%)	Crude Fiber (%)	Starch Content (%)
A1B1	11.449	0.9239	0.1226	8.4057	2.3106	78.7426
A1B2	10.9478	0.7186	0.0963	8.5773	2.2875	79.6069
A1B3	10.8476	1.0104	0.13195	8.6155	1.9279	78.1685
A2B1	10.3803	0.8416	0.0805	8.6	2.5736	77.9462
A2B2	10.4619	0.7812	0.0703	8.5485	2.5693	78.3968
A2B3	10.0254	0.8791	0.0557	8.6243	2.4511	72.9037
A3B1	10.4497	0.897	0.12985	8.7091	2.583	77.4041
A3B2	8.6938	0.9072	0.1	8.6931	2.417	75.9357
A3B3	10.3702	0.9353	0.1034	8.52805	2.446	72.2389
K	7.8275	5.2691	0.2479	8.4402	2.1419	69.1504

Where A1B1 : elephant foot yam flour with acid modification of 5% and soaked for 30 min, A1B2 : elephant foot yam flour with acid modification of 5% and soaked for 60 min, A1B3 : elephant foot yam flour with acid modification of 5% and soaked for 90 min , A2B1 : elephant foot yam flour with acid modification of 10% and soaked for 30 min, A2B2 : elephant foot yam flour with acid modification of 10% and soaked for 60 min, A2B3 : elephant foot yam flour with acid modification of 10% and soaked for 90 min, A3B1 : elephant foot yam flour with acid modification of 15% and soaked for 30 min, A3B2 : elephant foot yam flour with acid modification of 15% and

soaked for 60 min, A3B3 : elephant foot yam flour with acid modification of 15% and soaked for 90 min, K : elephant foot yam flour without treatment (Control)

The protein content of elephant foot yam flour treated with acid modification and the control elephant foot yam flour was relatively similar, with protein content ranging from 8%. The acid modification treatment did not degrade protein content of elephant foot yam flour. The content of crude fiber of elephant foot yam flour, either with acid modification treatment and control does not have much different, that is around 2%. Meanwhile, the acid modification treatment on the elephant foot yam flour is able to decrease the fat content of the flour from control condition (0.24%), to be (0.05%) on the elephant foot yam flour which has undergone acid modification treatment with a 10% acid concentration and soaked for 90 minutes (Table 1.). The water absorption capacity of a material is influenced by the presence of fiber, due to the water-absorbing nature of the fiber[7].

The development of fiber during cooking process also contributes to the rise of KPA of the flour[8].Increased fiber also occurs due to the increase of insoluble fiber, because the resistant starch formed by starch modification process is included in dietary fiber[9].

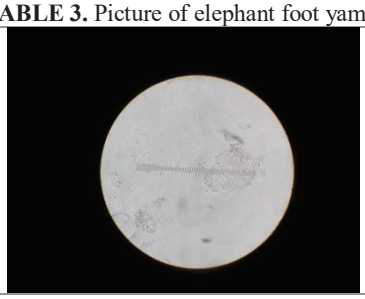
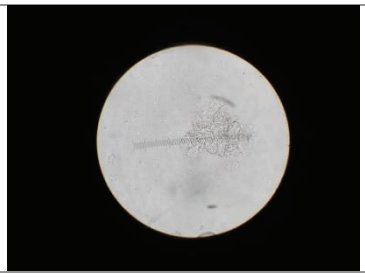
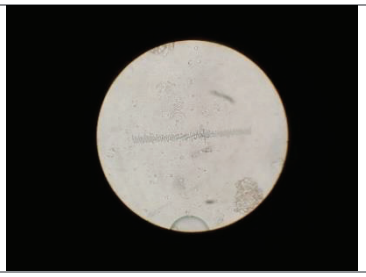
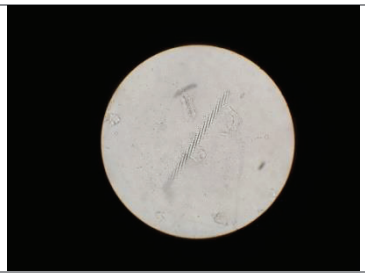
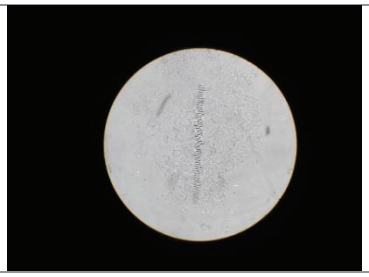
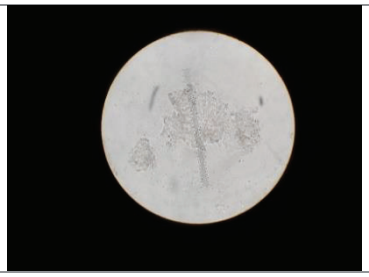
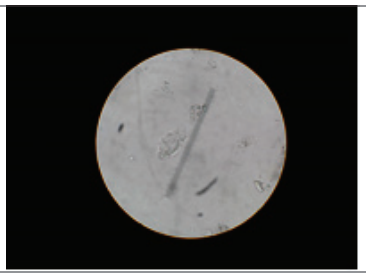
Starch flour with high protein content causes less starch viscosity decreases, this causes the quality of starch decreased so it is not expected in its utilization. Proteins and starches will form complexes with granular surface and cause starch viscosity to drop[10]. If the starch content of the tuber has reached the optimum, then the starch on the tuber will continue to fall slowly and begin to change the starch into fiber[11].

TABLE 2. Results of Color Level Test of Experimental and Control Elephant Foot Yam Flour

Sample	**Analysys Result**		
	L (dark 0 - white 100)	A ((-)green – (+)red)	B ((-)blue – (+)yellow)
A1B1	68.75	8.065	11.415
A1B2	69.14	7.245	9.665
A1B3	69.42	6.72	9.035
A2B1	68.39	8.285	11.925
A2B2	63.095	7.365	9.925
A2B3	68.61	6.815	9.395
A3B1	68.885	8.35	12.315
A3B2	66.47	8.23	11.745
A3B3	68.455	7.59	11.555
K	62.49	8.12	10.785

Acid modification treatment in elephant foot yam flour degrading starch polysaccharide and fat of elephant foot yam flour became simpler structure, which is also suspected to be the cause of starch color of elephant foot yam flour change to become brighter after acid modification treatment (from range L = 63 to L = 69) (Table 2.). The reddish color of elephant foot yam flour which is suspected to be derived from the fat content image, is fading with acid modification treatment (from a = 8 to a = 6). Meanwhile, the rising yellow color image from the blue elephant foot yam flour is suspected to be a representation of starch polysaccharides degradation to simpler carbohydrates (Table 2.)

TABLE 3. Picture of elephant foot yam flour granules after acid modification tretment and control

	
SAMPLE A1B1	**SAMPLE A1B2**
	
SAMPLE A1B3	**SAMPLE A2B1**
	
SAMPLE A2B2	**SAMPLE A2B3**
	
SAMPLE A3B1	**SAMPLE A3B2**
	
SAMPLE A3B3	**SAMPLE CONTROL**

Based on Table 3, it shows that acid modification treatment causes the photo profile of granules of elephant foot yam flour to be more turbid than the original elephant foot yam flour condition (control). The profile of elephant foot yam flour before acid modification treatment tends to be somewhat transparent, rigid and non-porous. However,

after acid modification treatment, pores appear in starch granules and the starch granules tend to expand (swelling) and fragile. Acid modification treatment at 15% acid concentration with 30 minutes of soaking succeeded to change the structure of carbohydrate of elephant foot yam flour granule and hydrolyze it into oligosaccharide so that the starch level decreased, penetration of water content is rising, the sugar content is allegedly rising, the color changed into brighter, more delicate and soft texture, and more easily processed due to the fragile and swollen granular structure. Water absorption is related to granular composition and physical nature of starch after water addition, thus water absorption also determines the amount of water needed for the immersion process. The gel formation cannot be optimum if the amount of water added is less[11].

CONCLUSION

The acid modification as chemical treatment on elephant foot yam flour in this study was able to change the functional properties of elephant foot yam flour towards a better processing characterized by a brighter color (L = 80, a = 8 and b = 12), the hydrolysis of polysaccharides flour into shorter chain (flour content decreased to 72%), the expansion of granules in elephant foot yam resulting in a process – ready flour, and better monolayer water content of 11%. The content of protein and fiber on the elephant foot yam flour also can be maintained at a level of 8% and 1.9% levels.

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