Investigation of the Effect of Heat Moisture Treatment on Local Sweet Potato Starch Characteristics

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Abstract
The aimed of this study was to determine the effect of Heat Moisture Treatment (HMT) method on the characteristics of local sweet potato starch. Sweet potato starch were isolated from three varieties, namely based on their flesh colour white, light yellow and purple. The native sweet potato starch clasified into two groups; non HMT groups and HMT groups. The native sweet potato starch with HMT treatment were adjusted to moisture content of 25% and exposed to HMT at 110˚C for 3 h. The native and treated starches were characterized for starch physicochemical characteristics espescially total dietary fibre (TDF) which is increased significatly.
Key words: Heat Moisture Treatment, sweet potatoes, starch.

Introduction

Sweet potatoes (Ipomea batatas L) is one of the Indonesian agricultural products that have high production values with different varieties to be developed and utilized as intermediate products as dry starch which can be further processed by the food processing industry and non-food industry. However sweet potato starch in the manufacture of foodstuffs are often encountered obstacles. Therefore, the necessary modifications of sweet potato starch by Heat Moisture Treatment (HMT) is expected to improve physical and chemical characteristics of the starch. Recently, studies on the formulation of sweet potato starch noodles and sweet potato flour has been done. Yet some things still require further study include the modification of sweet potato starch in order to obtain the same as characteristic as wheat flour.

Native starch which is used as raw material for some products such as noodle has some weakness; insoluble in cold water, longer cooking time, rigid pasta-produced, and have low stability. Modified starch is aimed to enhance starch utilization in food industry, more stable and has better texture. Moreover to increase gelatinization temperature and heat resistance as well as its viscosity, its need modification. Principally, HMT is the exposure of starch to higher temperature, commonly above the gelatinization temperature, at very restricted moisture content (18-27%) (Lilia et al, 1999). HMT method is more natural and safe to be applied compared with chemical methods. HMT is lead to decrease starch solubility compare to native strach. Furthermore many researchs have been established in relation to starch solubility. HMT changes the molecular structure of starch (Jacobs and Delcour, 1998; Collado and Corke, 1999; Stute 1992; Singh et al, 2005). This process could lead to produce slowly digested starch that is seems to be associated with lower glycemik index value. Therefore the general objective of this study is investigated protein, fat, total dietary fibre (TDF), water content and ash of native and treated starch of local varieties differ in their flesh colour.

Materials and Methods

Materials

Three varieties of sweet potatoes differ in their flesh colour (light cream, yellow, and purple) were collected in Saree, Aceh Besar.

Starch extraction

Sweet potato tubers were washed, peeled off, grated and extracted using distilled water in the ratio of water : sweet potato at 1:1, and filtered to obtain filtrate 1. Cake resulted was added with distilled water at the water : cake ratio of 1:0.5, squeezed and filtered through the same mesh to obtain filtrate 2. Filtrate 1 and filtrate 2 were mixed, settled down for 6 h, and the water was replaced every 3 h. Water and sediment were separated, and the sediment obtained was to be wet starch which was then dried overnight using oven at 50°C. The dry starch was milled and sieved with 100 mesh and then kept in sealed container (Collado and Corke, 1997)

Heat Moisture Treatment (HMT)

Heat moisture treatment was carried out with the method of Collado et al. (2001). The moisture content of the native starch was adjusted to 25% by adding distilled water and kept at 5-6˚C overnight. The samples was then heated in the oven at 110˚C for 3 h. After that the samples were immediately cooled to avoid further gelatinization and dried in oven drying 50˚C. The treated starch was cooled at ambient temperature and pack for further analysis.

Proximate analysis and TDF

Water content, ash, TDF and fat were analyzed using AOAC method (2000). Crude protein content using micro Kjedahl method (Conversion factor 6,25).

Results and Discussion

Water content, ash, fat, and crude protein content

Water Content, ash, fat, and crude protein content shows in Table 1. Water content, fat, and crude protein show significat different between native and treated starch, however ash show not significant different among them. For some reason sweet potato is not such a kind of fat and protein resource. The content of proximate analysis is varied among sweet potatoes genotype. Fat and crude protein after treated with HMT is lower than before. This is could be happen because some of fat and protein molecules were detoriated during heating process.

Table 1. Physichochemical properties of native and treated starch of local sweet potato

Parameter (%)	Native Starch (Non-HMT)			Treated Starch (HMT)			P value
	yellow (v1)	purple (v2)	light cream (v3)	yellow (v1)	purple (v2)	Light cream (v3)	
Water content	7.11	7.31	6.70	8.83	8.86	8.84	<0.001
Ash	0.44	0.44	0.66	0.83	0.49	0.33	0.444
Fat	34.478	37.262	39.471	7.60	6.02	8.7	<0.001
Crude Protein	33.85	47.27	35.02	8.46	9.05	9.92	<0.001

Total dietary fibre (TDF)

Total dietary fibre is associated with digestibility and clasified as undigestable stach. HMT process could lead to produce slowly digested starch that is seems to be associated with lower glycemik index value. The result of total dietary fibre was increased with the treatment (Figure 2).

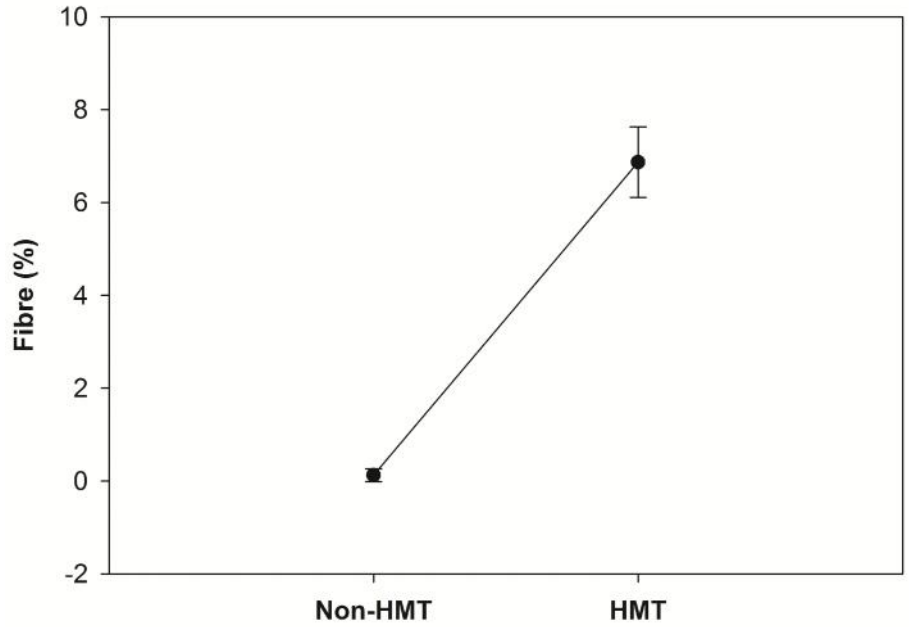

Figure 2. Fibre content of Non-HMT and HMT treatments

TDF show insignificant different among varieties but showed different significant between native (Non-HMT) and treated starch (HMT). Total dietary fibre increase after HMT process. This study is closely similar to previous study conducted by Senanayake, et al. (2014) and Pranoto et al. (2014).

HMT method can change the characteristics of starch by increase the gelatinization temperature, increase the viscosity of starch paste, and increase the tendency of retrogradation (Adebowale et al. 2005). The cyrstalin starch structure impove along with higher temperature (above gelatinization temperature), so that starch has perfectly gelatinized. In other hand a previous research done by Pranoto et al. (2014) which is used the period of HMT time stated that with the longer HMT will increased solubility due to the weakness of molecular binding of starch intermolecul. According to Syamsir, et al. (2012) the changes of the starch molecular that is lead to increase TDF will be not proceed under moisture content (<20%), and lower temperature.

Conclusions

HMT led to decrease solubility which is resulted in higher total dietary fibre (significant different P< 0,001).

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References

Adebowale, K.O., Owolabi, B.I.O., Olawumi, E.K., and Lawal O.S. (2005). Functional Properties of Native Physically and Chemically Modified Breadfruit Starch. Industrial Crops and Product. 21: 343-351.

Collado, L.S., and Corke, H. (1997). Properties of Starch Noodles as Affected by Sweetpotato Genotype. Cereal Chemistry. 74: 182-187.

Collado, L. S., and Corke, H. (1999). Heat-moisture Treatment Effects on Sweet potato Starches Differing in Amylose Content. Food Chemistry. 65:339-346.

Collado, L.S., Mabesa, L.B., Oates, C.G., and Corke, H. (2001). Bihon Type Noodles from Heat Moisture Treated Sweet Potato Starch. J. of Food Sci. 66 (4): 604-609.

Jacobs, H., Delcour, JA. (1998). Hydrotermal Modification of Granular Starch with Retention of the Granular Stucture: A Review. J. Of Agr. and Food Chem. 46: 2895-2905.

Pranoto,Y., Rahmayuni., Haryadi and Rakshit, S.K. (2014). Physicochemical Properties of Heat Moisture Treated Sweet Potato Starches of Selected Indonesian Varieties. International Food Research Journal. 21(5): 2031-2038.

Senayake, S., Gunaratme, A., Ranaweera, K.K.D.S., and Bamunuarachchi, A. (2014). Effect of Heat Moisture Treatment on Digestibility of Different Cultivars of Sweet Potato (*Ipomea batatas*) Starch. Food Science and Nutrition. 2(4): 398-402.

Singh, S., Raina, C.S., Bawa, A.S., Saxena, D.C. (2005). Effect of Heat Moisture Treatment and Acid Modification on Rheological Textural, and Differential Scanning Calorimetry Characteristics of Sweetpotato Starch. J. of Food Sci. 70: 373-378.

Stute, R. (1992). Hydrothermal Modification of Starches: The Difference Between Annealing and Heat Moisture Treatment. Starch. 44: 205-214 .

Syamsir, E., Hariyadi, P., Fardiaz, D., Andarwulan, N., and Kusnandar, F. (2012). Effect of Heat Moisture Treatment Process on Physicochemical Characteristic of Starch. A Review in J. Teknologi dan Industri Pangan. 23 (1).