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The changes of starch and sugar on fermented of mixture of cassava and sweet potatoes using local tape ragi

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Abstract. The aims of this study is to determine the change of starch and sugar content on cassava roots and sweet potato substrates through local “Tape Ragi” fermentation. The type of research is experiment with solid substrate fermentation method. The cassava roots and sweet potato mixture substrate is made with variation of concentration 1:0; 1:1; 1:3; 3:1 and 0:1. The tape ragi used is obtained from the traditional market of Bone regency of South Sulawesi province which is the result of selection in previous research. Analysis of starch content on products using enzymatic methods. The principle of analysis by such methods is starch extracted by dimethyl sulfoxide and acid, hydrolyzed by enzyme amyloglucosidase into sugar. The sugar content is determined by the determination of total sugar, and the starch content is 0.9 times the sugar content. The results of this study shows that the fermented mixture of cassava roots and sweet potatoes using local tape ragi B causes changes in starch and sugar levels. Level of starch on cassava roots subtract treatment (K), mixture of cassava roots and sweet potato with ratio 1: 1 (K1J1) and cassava roots and sweet potato mixture with ratio 3: 1 (K3: J1) decreased. The treatment of sweet potato substrate (J) and cassava roots mixture and sweet potato mixture with ratio of 1: 3 (K1J3) actually increased to 24.84% from 22.78% before fermentation and 33.57% from 27.48% before fermentation. All variations of the substrate treatment experienced a change in the increase in the amount of sugar content after fermentation using local tape ragi.

1. Introduction

Cassava is quite rich in starch as a cheap source of carbohydrates and has a high energy density of around 610 kJ/100g of fresh roots. Excess cassava compared to other plants is that it can grow in soil with low fertility, resistant to pests and drought. Cassava roots have a relatively high energy content with relatively low crude fiber, but cassava roots as foodstuffs also have disadvantages, namely low levels of protein, minerals, vitamins, and the presence of antinutrients, namely cyanide acid (Tivana, 2012).

Sweet potatoes do not have cyanogenic limitations associated with cassava, but are less well known. This can be attributed to relatively low utilization rates. Nutrition, sweet potato is one of the very high caloric foods (providing 90 calories / 100 g vs. 70 calories / 100 g tubers), a source of rich dietary fiber, antioxidants, vitamins, and minerals. This is a good source of vitamin A (28). However, sweet potatoes cannot yet be recognized as a vital ingredient in food production and safety (Sobuoka *et al.*, 2010, Sullivan *et al.*, (1997), Umesh (2009) in Karim *et al.*, 2016). Sweet potato natural starch has a low



viscosity value, has a limited development pattern during heating and tends to be easily degenerated. Therefore, modification of starch is needed. By treating cassava roots through a fermentation process using local tape ragi, it is expected that the characteristics of sweet potato flour are better.

In Indonesia, "ragi" is made with rice flour and is sold as white, somewhat flattened balls about 3 cm in diameter (Hesseltine 1965). Yeasts thought to be present in tape ragi include *Saccharomyces cerevisiae* and *Pichia anomala*, The Mucoraceous molds of *Rhizopus oryzae* and *Chlamydomucor oryzae* contribute substantial quantities of amylase which eventually saccharify cassava or rice starch during the second stage of fermentation. Commonly known types of "ragi" are bread ragi, tape ragi, and tempeh ragi. Ragi containing microflora such as mold, yeast and bacteria can function as fermentation starters and can increase the nutritional content of fermented products (Beuchat, 1987 ; Suliantari and Rahayu, 1990).

Traditional fermented food products or beverages which are the result of enzyme activity from microorganisms, are found in many areas in Indonesia. Southeast Sulawesi province, for example, has traditional fermented food known as "tape singkong" and "tape ketan." "Tape singkong" is a traditional food made from a sweet cassava root (*Manihot esculenta* Crantz) by a fermentation process. In the process of fermentation in the manufacture of tape, carbohydrates (starch), react with enzymes or hydrolysed to produce glucose. Glucose will undergo a process of fermentation (fermentation) and produce ethanol / alcohol. In the curing process of cassava, must be controlled temperature and time. Namely at room temperature with time 3x24 hours (Suliantari and Rahayu, 1990).

2. Experimental Details

The local tape ragi used as a starter is B tape ragi which is the result of selection of 5 types of local tape. The tape ragi is smoothed out and ready to use as a starter. and counting the number of living cells (viability) of microorganisms by Standard Plate Count (SPC) method (Cappucino & Sherman, 1987). Tape ragi powder that has known quantity/viability microbe ready for use as an inoculum or starter on fermentation mixture of cassava roots and sweet potato (McNeil and Harvey, 1990). The cassava roots used were sweet cassava (*Manihot esculenta* Crantz) with a harvesting age of 6-8 months, while sweet potato (*Ipomoea batatas* L.) used were purple sweet potato (Ayamurasaki) with a harvesting period of 3 - 4 months.

Cassava and sweet potatoes are peeled, washed and cut into small pieces, then steamed separately for 30 minutes of cassava roots and 20 minutes for sweet potatoes. The steamed cassava roots (K) and sweet potato (J) are each weighed according to mixed treatment variations and fed into a number of sterile fermentors according to the mixed substrate variations. The substrate was sterilized with UV lamp 2 x 45 minutes, then each substrate in the fermentor was inoculated with a tape ragi inoculum as much as 10% then fermented at room temperature with 2 days fermentation time. Further analysis of starch and sugar content of fermented cassava roots products from the results of all treatment variations. Analysis of the chemical composition of cassava roots and sweet potato mixture of local tape ragi fermentation comprises starch and sugar content using enzymatic method (AOAC, 1990; Ghofar *et al.*, 2005; Sudarmadji, *et al.*, 1984).

3. Results and Discussion

The content of starch on substrate with variation of cassava roots and sweet potatoes mixture is determined by enzymatic method. The principle of analysis by such methods is starch extracted by dimethyl sulfoxide and acid, hydrolyzed by enzyme amyloglucosidase into sugar. The sugar content is determined by the determination of total sugar, and the starch content is 0.9 times the sugar content. Data of analysis of starch content of substrate of cassava roots and sweet potato mixture are listed in Table 1.

Table 1. Results of Analysis of Starch Content of Fermented Mixture Products of Cassava Roots and Sweet Potatoes

No.	Treatment	Starch Content (%)	
		Before Fermentation	After Fermentation
1	K	38.38	37.38
2	J	22.78	24.84
3	K1J1	29.00	27.85
4	K1J3	27.48	33.57
5	K3J1	35.76	34.38

Tabel 1 data shows that there is a change in starch content in all substrate treatment variations. Cassava roots substrate (K) treatment decreased starch content after fermentation using local tape ragi to 37.38% after fermentation of 38.38% before fermentation. Similarly, the treatment of substrate mixture of cassava and sweet potato with a ratio of 1: 1 (K1J1) and a mixture of cassava and sweet potato with a ratio of 3: 1 (K3: J1), also decreased to 27.85% from 29.00% and 34.38 % of 35.76% before fermentation. On the contrary, the increase of starch content after fermentation occurred in the substrate of purple sweet potato without cassava (J), ie from 22.78% to 24.84%, and fermented cassava and sweet potato mixture with a concentration of 1: 3 (K1J3), ie from 27.49% to 33.58 %. This result can be seen more clearly in Figure 1.

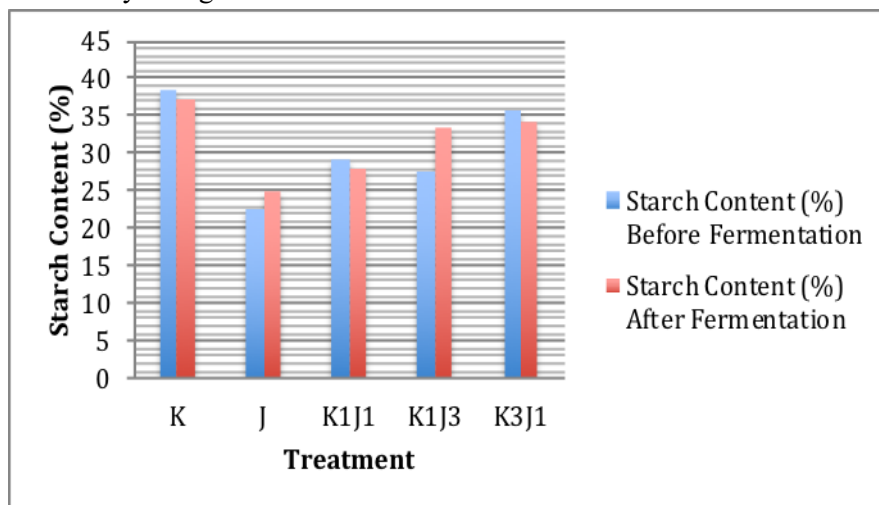


Figure 1. Histogram of change of starch content Fermented Mixture Products of Cassava Roots and Sweet Potatoes.

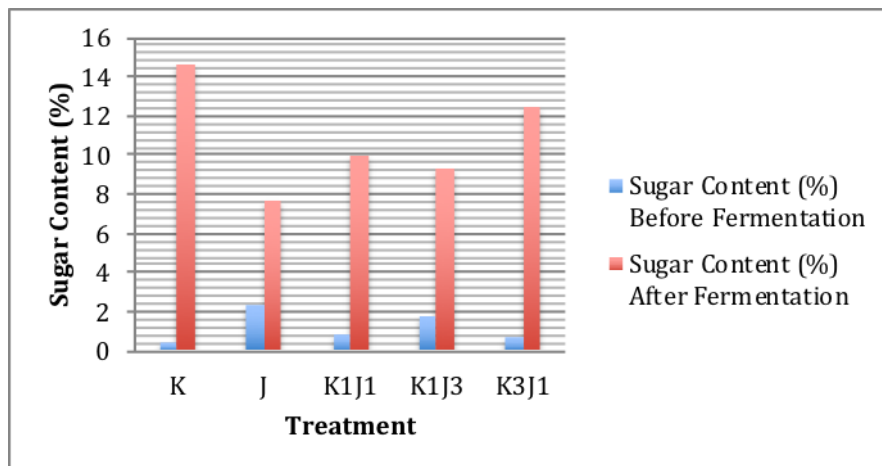
Based on the results of this study and Figure 1, it is known that the substrate with a ratio of purple sweet potato more than cassava roots has increased starch levels. This research is confirmed by the results of Yadang et al. (2013) that sweet potato starch content increased after fermentation from 1 day to 5 days, ie from 76.57 g / 100 g to 87.49, 89.65, 90.05, 90.56 and 91.25 g / 100 g.

The results of the analysis of the sugar content of fermented cassava roots and sweet potato mixture products are listed in table 2.

Table 2. Results of Sugar Level Analysis of Fermented Products Mixed Cassava Roots and Sweet Potatoes

No.	Treatment	Sugar Content (%)	
		Before Fermentation	After Fermentation
1	K	0.44	14.64
2	J	2.34	7.61
3	K1J1	0.86	10.05
4	K1J3	1.78	9.33
5	K3J1	0.65	12.4

Data Table 2 and figure 2 shows that all variations of substrate treatment experienced changes in the amount of sugar content after fermentation using local tape ragi.

**Figure 2.** Histogram of change of sugar content fermented mixture products of cassava roots and sweet potatoes

It is interesting in the results of the analysis of sugar content, it is known that an increase in sugar content after fermentation using local “tape ragi” respectively from the highest to the lowest based on the concentration of cassava roots in the substrate mixture. The highest increase in sugar content occurred in cassava roots without purple sweet potato (K) mixture which was 14, 20%. Furthermore, consecutively in the treatment of cassava roots and sweet potato mixture with a ratio of 3:1 (K3J1) that is equal to 11.75%, treatment of cassava roots and sweet potato mixtures with a ratio of 1: 1 (K1J1) of 9.19%, treatment of cassava roots mixture and sweet potato with a ratio of 1: 3 (K1J3) of 7.55% and the lowest in sweet potato treatment without cassava roots mixture (J), only at 5.27%.

According to the results of research by Karim *et al.* (2016), there was a decrease in the carbohydrate content of the cassava-sweet potato *gari* with increased level of sweet potatoes incorporation which suggests that the cassava roots used had more carbohydrate content than the sweet potatoes used, or sweet potatoes incorporation increased level of fermentation which consequently resulted to higher level of carbohydrate break down. This might be as a result of higher sugar content in sweet potatoes which is the main substrate for fermentation. Sweet potatoes contain simple sugars such as glucose, fructose, sucrose and maltose which make up about 32% of its carbohydrate content.

4. Conclusion

In conclusion, this study shows that fermented mixture of cassava roots and sweet potatoes using local “ragi tape” causes changes in starch and sugar levels. Level of starch on cassava roots subtract treatment (K), mixture of cassava roots and sweet potato with ratio 1: 1 (K1J1) and cassava roots and sweet potato mixture with ratio 3: 1 (K3: J1) decreased. The treatment of sweet potato substrate (J) and cassava roots mixture with ratio of 1: 3 (K1J3) actually increased to 24.84% from 22.78% before fermentation and 33.57% from 27.48% before fermentation. All variations of the substrate treatment experienced a change in the increase in the amount of sugar content after fermentation using local “tape ragi”.

References

- [1] AOAC, 1990. Official Methods of Analysis. 15th ed. Agricultural Chemicals, Contaminant, Drugs., Vol 1., Association of Official Analyticals chemists., Washington D.C.
- [2] Beuchat, L.R. 1987. Food and Beverage Mycology. 2nd Ed. Van Nostrand Reinhold, New York.
- [3] Cappucino, J.C and Sherman, N. (1987). Microbiology : Laboratory Manual. The Benjamin Cummings Publishing Company.
- [4] Ghofar, A., S. Ogawa and T. Kokugan. 2005. Production of L-Lactic Acid from Fresh Cassava Roots Slurried With Tofu Liquid Waste by *Streptococcus bovis*, J. of Bioscience and Bioengineering
- [5] Karim, O.R., B. M. Adebanye, O. A. Akintayo, and W. Awoyale. 2016. Physical, Chemical and Sensory Properties of Cassava (*Manihot esculenta*) – sweet potato (*Ipomoea batatas*) gari. Ukrainian Journal of Food Science. 2016. Volume 4. Issue 2
- [6] McNeil, B. and L. M. Harvey. (1990). Fermentation : A Practical Approach. Oxford University Press, New York.
- [7] Pusparani, T. dan S. S. Yuwono 2014. Pengaruh Fermentasi Alami Chips Ubi Jalar Terhadap Sifat Fisik Tepung. Jurnal Pangan dan Agroindustri Vol. 2 No 4 p.137-147, Oktober 2014
- [8] Sudarmadji, S., B. Haryanto, dan Suhardi. 1984. Prosedur Analisa untuk Bahan Makanan dan Pertanian. Edisi ketiga. Penerbit: Liberty, Yogyakarta.
- [9] Suliantari dan W. P. Rahayu. 1990. Teknologi Fermentasi Biji-Bijian dan Umbi-umbian. Depdikbud Dirjendikti-PAU IPB, Bogor.
- [10] Yadang, G., I.L. Mbome, and R. Ndjouenkeu. 2013. Changes in Amylase Activity, hot-paste Viscosity and Carbohydrates During Natural Fermentation of Sweet Potato (*Ipomoea batatas*), African Journal of Food Science and Technology ((ISSN: 2141-5455) Vol. 4(8) pp. 188-194

Acknowledgments

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