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Added value improvement of taro and sweet potato commodities by doing snack processing activity

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ABSTRACT

Tubers processing is one of efforts to support program on food diversification utilizing local foods. Introduction of processing technology of taro and sweet potato tubers to be flour and snack products (stick and chip) was done to disseminate the technology in farmer level in order to improve the commodities' added value and later could improve farmer's welfare. The introduction was done in "Mekar Sari" women group in Bali on June up to December 2013. The result showed that women group can prepare good quality products by themselves. With R/C ratio is more than one, food processing activities are feasible to be done. By selling flour, prospective revenue accepted was IDR 85,125 or 3.4 times higher than selling fresh tubers and even could become IDR 191,906 or 7.7 times higher if they processed at least one of snack products (stick).

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Keywords: taro, sweet potato, flour, snack, added value

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Introduction

High carbohydrate resource is well known from serealia and tubers. Two of tubers which are known as local commodities and have high carbohydrate content are taro and sweet potato although the content are not higher than cassava and serealia, like rice, corn, and wheat. Tubers of taro and sweet potato can be processed to be various food products, both intermediate products such as flour, paste, etc and also final ones such as snack, noodle, cakes, etc. The processing of taro and sweet potato to be food products is suitable to program of Indonesian government in food diversification using local food commodity.

Taro (*Colocasia esculenta*(L.) Schott), involved in tubers family (*Araceae*) is seasonal or perrenial crop. Taro has some of name such as Old cocoyam, Abalong (Phillipine), Taioba (Brazil), Arvi (India), Keladi (Malaysia), Satoimo (Japan), Tayoba (Spanyol), and Yu-tao (China). In Indonesia, centre of taro commodity are in Bogor (West Java) and Malang (East Java). The highest component of taro is starch (77.9%) with 17-28% of amylose and 72-83% of amylopectin. The high content of amylopectin causes sticky characterisctic on taro like a sticky-rice. Starch of taro is digestable therefore it is suitable to be used as infant food products. Taro has some essential amino acids although it is lack for hystidin, lysin, isoleusin, triptophan, and metionin [1].

Sweet potato (*Ipomea batatas*) is the fourth of carbohydrate main resource after rice, corn, and cassave consumed by Indonesian people. It is usually consumed in its primary processed forms, such as steamed, boiled, and grilled or processed to be chip or 'kolak' (traditional food). Intermediate products of sweet potato such as flour, paste, puree, and mash produced by food industry generally to be used as export commodity, not for local consumption [2]. Sweet potato has complex carbohydrate therefore its energy is released gradually. Consumed with its peal, steamed or boiled sweet potato contain higher fiber than oatmeal so it is suitable for diet and can substitute rice, potato or boiled corn. With low glycemic index (GI), sweet potato is suitable for people with diabetic [3].

One of products processed from taro and sweet potato tubers is flour. The processing of flour from non-rice commodity is expected to be able to overcome Indonesian dependency on wheat flour which increases year by year. Caturini recorded that Indonesian's need of wheat flour in 2010 was 2.93 million tonnes and increased 2% in 2011 [4]. Besides, flour is one of suggested intermediate products because it is easy to be stored, to be composed, to be fortified, to be formed, and to be cooked as a demand of modern life-style [5]. The advantage of flour processing are its flexibility for food industry, safe in distribution, save in storage and storage cost [6]. Flour is grouped into single flour and composite flour. Single flour is produced from one of food

commodity such as rice flour, tapioca, etc [6]; while composite flour is mix of wheat flour and non-wheat flour or flour made from some kinds of serealia flour, or tuber flour, or legume flour [7]. The aim of composite flour production is to obtain the preference characteristic of raw material and to obtain specific functional characteristic [6].

Development of various flour agroindustry in rural level is expected to improve added value of commodity as well as to improve community welfare. However, processing technology of taro and sweet potato composite flours has not been attented by community yet, even has not had market chance yet since it's utility is unknown well. Therefore, dissemination of processing technology and the used of taro and sweet potato composite flours in farmer level is important to be conducted.

In some countries, taro processed into flour product can substitute rice or diversify food. Taro flour is processed to be infant food in USA, various cakes in Phillipine and Colombia, bread di Brazil, and various food such as 'enyek-enyek', 'dodol' (sticky-cake), and taro-stick in Indonesia. While, sweet potato flour can be use as a raw material in food and chemical industry.

The utility of composite flour of taro and sweet potato introduced was snack such as stick and chip. In Indonesia, snack has been developed rapidly in form of kind of snack, its raw material, as well as its packaging. One of snack developed well in market is chip. There are two groups of chip, i.e. traditional or general chip and simulation chip. General chip is made from the processes of cutting and cleaning, thin cutting, and frying; while, simulation chip is made from flour which is through the process of mixing, thin layer forming, molding, and frying. Compared to general chips, the simulation one has some advantages such as (1) form and size can be mold as a preference and uniform; (2) seasoning can be applied easily; and (3) higher yield [8]. For snack-making, the use of composite flour can substitute the use of wheat flour up to 100%.

Material and Methods

Introduction of processing technology of taro and sweet potato composite flour was conducted in women farmer group named 'Mekar Sari' in Pelaga village, Petang subdistrict, Badung, Bali in form of school field. The activity was conducted on June up to December 2013. Products resulted was analyzed using proximate analysis in Laboratory of Agricultural Processing Technology, Udayana University, Bali.

Materials

Materials used for flour processing were tubers of taro and sweet potato, water, and citric acid. Materials used for stick product were composite flour, salt, egg, and condiments (onion,

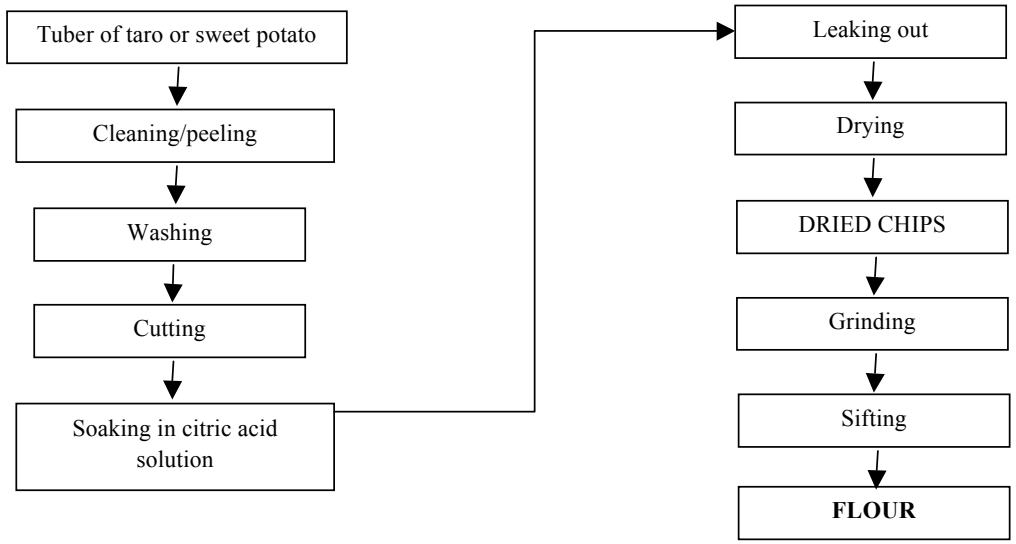
garlic, coriander, chili, etc), water, margarine, and vegetable oil; while, materials for simulation chip were composite flour, refined sugar, salt, water, spices, and vegetable oil.

Utensils used for flour processing were basin, knife, grinder, riddle, etc. Utensils for stick processing were basin, noodle maker, frying pan, etc; while, utensils for chip processing were basin, steamed pan, frying pan, etc.

Processing Procedure

Flour of Taro and Sweet Potato

Simply, processing of taro and sweet potato flour is as follow:



Picture 1. Scheme of taro flour and sweet potato flour processing [9]

Stick Processing

Stick product was made using modified Hafizah's recipe [10]. The recipe used wheat flour as a raw material of stick product; while for this research, it used composite flour of taro and sweet potato. Simply, processing of stick product is as follow:

Composite flour was mixed with other materials such as salt, egg, condiments:onion, garlic,etc and liquidated margarine. The dough is stir then add water some by some until the dough is not sticky. The dough then pressed using noodle maker for some times, and cut into stick-form. Stick fried until the colour turn into yellowish then raised the stick from frying pan and leak the rest of oil out. Store the product in container after temperature has turned into room temperature.

Simulation Chip Processing

Simulation chip is made as processing procedure of Susila[11] and as mentioned in *eBookPangan.com*[8]. The procedure is as follow:

Composite flour was mixed with refined sugar, salt, water, and grinded condiments of onion, garlic, coriander and chili then make a dough with porridge-consistency. A dough make into thin layer using noodle maker then the layer steamed for 5-10 minutes. The layer dried under the sun for 3-4 hours then cut a semi-dry layer into a preference form then continue the drying process until to be raw-chip. Raw-chip is ready to be fried in temperature of 160-190^{o}C for 10-15 seconds.

Analysis Methods

Data obtained from proximate analysis then analyzed descriptively.

Financial feasibility of processing activity is analyzed using R/C ratio. If R/C ratio value is more than one, it is meant that processing activity is feasible to be done. R/C ratio formula is:

R/C Ratio = $\sum_{i=0}^{n} \frac{R_i}{C_i}$; R = revenue; C = cost

Results and Discussion

Flour of Taro, Sweet Potato, and Composite

Table 1 shows result of proximate analysis of flour products produced by farmer. Compared to Indonesia's national standard for cassava flour (SNI 01-2997-1996) [12] and wheat flour (SNI 01-3751-2006) [13] in Table 2, in general, water content of flour products produced in farmer level has met the requirement of Indonesia's national standard. The lower water content of flour is important to minimize growth of contaminating microorganism during storage time, particularly fungi.

Table 1. Result of proximate analysis of flour products produced in farmer level

Chemical quality	Taro flour[1)]	Sweet potato flour[1)]	Composite flour of stick product[1)2)]	Composite flour for chip product[1)3)]
Water content (%)	8.64	7.10	7.68	8.25
Ash content (%)	2.51	2.42	2.25	2.45
Protein content (%)	4.10	2.27	3.39	3.61
Fat content (%)	1.67	1.63	1.17	1.82
Carbohydrate content (%)	83.08	86.58	85.52	83.86

1) Analysis result as issued by Laboratory of Agricultural Processing Technology, Udayana University, Bali.
2) Composite flour with composition of taro flour and sweet potato flour is 80% : 20%
3) Composite flour with composition of taro flour and sweet potato flour is 60% : 40%

On the other hand, as can be compared from Table 1 and Table 2, in general, ash content of flour product produced by farmer were higher than standard of comparison. High ash content can show high content of mineral in flour product as well as enzymatic reaction as a trigger of the lower of flour's white degree [14]. This is less preferred for flour product since it tends to cause dark colour. The high ash content of flour can be contributed by the high ash content of its raw material, for example ash content of sweet potato is 0.68 – 1.69% (db)[15].

Protein content of taro flour and sweet flour (Table 1) are much lower than protein content of wheat flour as Indonesia's national standard (Table 2). It is related to protein content of fresh tuber of taro and sweet potato which is not as high as protein content of wheat. Protein content in 100g of taro fresh tuber is 1.9g; while in 100g of steamed taro is 1.5g [1]. Protein content in fresh sweet potato is 3.71-6.74% (db) [15]. As comparison, the lowest protein content of wheat flour is 6-8% known as pastry flour and generally used for crispy products such as biscuit and chip; while the highest is 11-13% known as bread flour and used for products of bread, donut, noodle, and pasta [16].

Table 2. Indonesia's national standard (SNI) of cassava flour and wheat flour as standard of comparison

Chemical quality	SNI 01-2997-1996 for cassava flour	SNI 01-3751-2006 for wheat flour
Water content	Max 12.0%	Max 14.5%
Ash content	Max 1.5%	Max 0.6%
Protein content	n.a	Min 7.0%
Ash content	n.a	n.a
Carbohydrate content	n.a	n.a

n.a = *not available*

Stage of soaking in citric acid before drying, theoretically can help to cause white colour of flour [17]; however in this case, it may not be efective for flour product made from tuber of taro and sweet potato. Concentration of citric acid and soaking time used by farmer as a former research done by Elisabeth, et al. [18] that is 2.0% citric acid solution for 15 minutes for taro flour and 2,0% citirc acid solution for 20 minutes for sweet potato flour. Yield of taro flour is 17.19%; while yield of sweet potato flour is 16.86%.

Snack Product (Stick and Chip)

Result of proximate analysis of snack products produced by farmer is shown in Table 3. There is no specific standard for stick and simulation chip products in Indonesia, therefore as a comparison, SNI 01-4305-1996 [19] for cassava chip is used. As a former research by Elisabeth, et al. [18], making of stick product used composition of taro flour and sweet potato flour was 80% : 20%; while, simulation chip used composition of taro flour and sweet potato flour was 60% : 40%.

Water content of chip produced by farmer was too high (more than 12%) and it was much higher than water content standard in SNI. In this case, it was caused by the imperfect drying condition under the sun in farmer level. The high of product's water content should be awared since it makes product is risky to be contaminated by fungi during its storage time.

The higher ash content of stick and chip products than standard of SNI may be contributed by the higher ash content of composite flour as its raw material (Table 1). For stick product, the high content of fat content (four times higher than fat content of chip) may be contributed by the use of egg and margarine as raw materials of stick product.

Table 3. Result of proximate analysis of stick and chip products produced in farmer level

Chemical quality	Stick product	Chip product	SNI 01-4305-1996 for cassava chip (as comparison)
Water content(%)	0.74	12.82	Max 6,00
Ash content (%)	2.74	3.52	Max 2,50
Protein content(%)	2.62	1.91	n.a.
Ash content (%)	38.29	8.94	n.a.
Carbohydrate content (%)	55.61	72.81	n.a.

n.a = *not available*

Analysis of Financial Feasibility

Table 4 shows financial feasibility analysis of taro flour and sweet potato flour processing; while, Table 5 shows financial feasibility analysis of stick and chip processing. Component of cost involved is material cost, equipment depreciation cost, and labor cost.

Material cost for flour processing involves cost for raw materials i.e. tuber of taro and sweet potato and cost for additional materials such as citric acid, packaging, product label, etc. Labor cost involves cost from cleaning or peeling stage up to flour sifting. If flour product produced by farmer can be sold for price of IDR 25,000 per kg (as selling price for white sweet potato flour in Bantul,

Yogyakarta), R/C ratio obtained are respectively 1.20 for taro flour processing and 1.18 for sweet potato processing. These two processing activities are feasible to be done by farmer.

Material cost for snack production involves cost for raw materials which are produced by farmers themselves i.e. taro flour and sweet potato, and cost for additional materials such as condiments, vegetable oil, packaging, product label, etc. Labor cost involves cost from dough mixing stage up to packaging. R/C ratio obtained are respectively 1.17 for stick processing and 1.29 for chip processing. Therefore, these two snack processing are feasible to be done by farmer.

Table 4. Financial analysis of taro flour and sweet potato flour

No	Description	Taro flour			Sweet potato flour		
		Quantity	Price	Total	Quantity	Price	Total
A	Material cost						
1	Taro/sweet potato	10 kg	1,250	12,500	10 kg	1,250[*)]	12,500
2	Other materials			10,285			10,285
	Cost (A)			22,785			22,785
B	Equipment depreciation cost			1,000			1,000
	Cost (B)			1,000			1,000
C	Labor cost	0.34375 wd[***)]	35,000	12,031.25	0.34375 wd[***)]	35,000	12,031.25
	Cost (C)			12,031.25			12,031.25
	Total Cost (A+B+C)			35,816.25			35,816.25
	Quantity of flour (kg)			1.719			1.686
	Production cost per kg (Rp)			20,835.51			21,243.33
	Product BEP (kg)[**)]			1.43			1.43
	Revenue (Rp)			42,975			42,150
	R/C ratio			1.20			1.18

[*)] In 2013, as the research conducted, price of sweet potato in farmer level was high i.e. IDR 4,500/kg. Flour processing could be done when the price is lower i.e. IDR 1,250/kg

[**)]Based on selling price of white sweet potato flour i.e. IDR 25,000/kg in Bantul District, Yogyakarta in 2013

[***)]wd = workday

Source: Elisabeth et al. [18]-revised

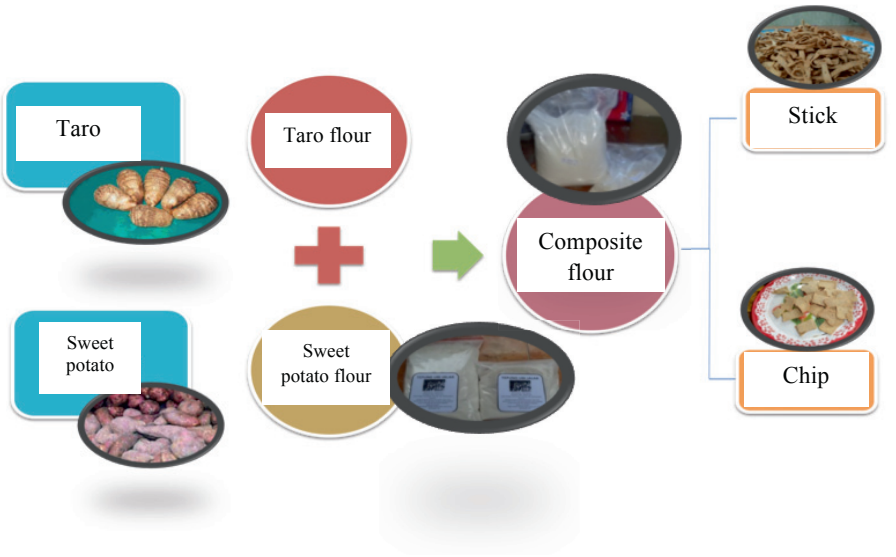
Table 5. Financial analysis of stick and chip products

No	Description	Stick product			Chip product		
		Qty	Price	Total	Qty	Price	Total
A	Material cost						
1	Taro flour	0.8 kg	25,000*)	20,000	0.6 kg	25,000*)	15,000
2	Sweet potato flour	0.2 kg	25,000*)	5,000	0.4 kg	25,000*)	10,000
3	Other materials			30,330			22,230
	Cost (A)			55,330			47,230
B	Equipment depreciation cost (assumption)			700			850
	Cost (B)			700			850
C	Labor cost	0.230 wd***)	35,000	8,050	0,291 wd***)	35,000	10,193.75
	Cost (C)			8,050			10,193.75
	Total Cost (A+B+C)			64,080			58.273,75
	Quantity of product (pack of 25g)			50			50
	Production cost per pack (IDR)			1,281.6			1,165.475
	Product BEP (pack of 25g)**)			42,70 (= 43)			38,85 (=39)
	Revenue (IDR)			75,000			75,000
	R/C ratio			1.17			1.29

*) Based on selling price of white sweet potato flour i.e. IDR 25,000/kg in Bantul District, Yogyakarta in 2013
**)Assumption: market price for product is IDR 1,500/pack with netto 25g
***)wd = workday
Source: Elisabeth et al. [18]-revised

Imrovement of Product's Added Value and Prospect of Additional Revenue for Farmer Group by Doing Product Processing

Added value is a difference between selling value of product minus other production cost. Economically, the improvement of product's added value can be done in four ways, i.e. form utility, place utility, time utility, and potition utility [20]. By doing the processing of flour and its food products, not only added value in form of form utility happened (Picture 2), but also financially added value as can be seen in Table 6.



Picture 2. Improvement of taro and sweet potato tubers' added value
Source: Slide of farmer's meeting of Elisabeth, et al. (2013) - unpublished

Financially, by doing processing activity from fresh tuber into flour and its food products, farmer's revenue has a prospect to be increased. By selling in form of fresh tuber commodity, 10 kg of taro and 10 kg of sweet potato share total revenue IDR 25,000 with selling price per kg fresh tuber is IDR 1,250. By doing intermediate product such as flour, farmer can obtain total revenue IDR 85,125 or 3.4 times higher than selling in form of fresh tuber. Quantity of flour obtained from 10 kg taro tuber and 10 kg sweet potato tuber is 1,7 kg per each tuber (with yield of about 17%), with assumption of selling price is IDR 25,000 per kg based on selling price of white sweet potato flour in Bantul District, Yogyakarta in 2013.

If farmer can continue the processing of flour into at least one kind of snack products, for example stick product processing, a prospect of farmer's additional revenue will be higher. With the assumption that all taro flour produced is prepared to be stick product, farmer has prospect to increase the revenue up to IDR 191,906 inwhich IDR 160,500 from stick product and IDR 31,406 from the rest of sweet potato flour not used in stick product processing. Assumed selling price of stick product packaged per each 25 g is IDR 1,500 as a selling price for similar product in market. By using all taro flour produced, i.e. about 1,7 kg, stick product obtained is 107 packs. This product made from mix of 80% taro flour and 20% sweet potato flour, therefore there is rest of sweet potato flour can be sold besides stick product. Same case happened if farmer want to process the flour into chip product as the detail can be seen in Table 6.

Table 6. Improvement of product's added value and its prospect for additional revenue of "Mekar Sari" women farmer group in Pelaga village (for 10 kg taro tuber and 10 kg sweet potato tuber processing capacity)

No	Taro fresh tuber		Sweet potato fresh tuber		Taro flour		Sweet potato Flour		Stick product		Chip product		Total (IDR)
	Q	R	Q	R	Q	R	Q	R	Q	R	Q	R	
1	10	12,500	10	12,500									25,000
2					1.719	42,975	1.686	42,150					85,125
3							1.2563	31,406	107	160,500			191,906
4							0.54	13,500			143	214,500	228,000

Note: Q means quality, R means revenue.
Description:

1. In 2013, as the research conducted, price of sweet potato in farmer level was high i.e. IDR 4,500/kg. Flour processing could be done when the price is lower i.e. IDR 1,250/kg
2. Based on selling price of white sweet potato flour i.e. IDR 25,000/kg in Bantul District, Yogyakarta in 2013
3. Marke t price for product is assumed IDR 1,500/pack with netto 25g
4. Yield of 1 kg of composite flour is 50 packs of stick product and chip product with netto 25g
5. Assumed in food processing all taro flour is used, then:
   a. Stick product needs 1.719 kg (80%) taro flour and 0.42975 kg (20%) sweet potato flour, rest of sweet potato flour is 1.2563 kg
   b. Chip product needs 1.719 kg (60%) taro flour and 1.146 kg (40%) sweet potato flour, rest of sweet potato flour is 0.54 kg

Source: Elisabeth et al. [18]-revised

Conclusion

Through the introduction of processing technology, women group has been able to prepare the products by themselves. The products have good chemical quality, however the high water content of chip which can cause high risk on fungi contamination during the storage time should be awared. With R/C ratio are respectively 1.20 for taro flour, 1.18 for sweet potato flour, 1.17 for stick product; and 1.29 for chip product, the food processing activities are feasible to be done. Besides, by doing processing activity, added value of product increased, both in form of its form utility and financial utility. By selling fresh tubers of taro and sweet potato per each was 10 kg, women group could accept total revenue of IDR 25,000; while by selling the flour products, prospective revenue accepted by women group was IDR 85,125 or 3.4 times higher and it even could become IDR 191,906 or 7.7 times higher if they processed at least one of snack products (stick) inwhich IDR 160,500 came from stick product and IDR 31,406 from the rest of sweet potato flour not used in stick product processing.

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