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The Effects of Cassava on Lupine, Peanut and Velvet Bean Red Oncom Fermentation Using *Neurospora sitophila*

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ABSTRACT

Nowadays, the usage of Australian sweet lupine (*Lupinus angustifolius*) and velvet bean (*Mucuna pruriens*) are still limited to animal feed. In this research, the effect of legumes varieties (peanut, Australian sweet lupine and velvet bean) and cassava flour concentration (5, 20, 35%) on red oncom characteristics was studied. Legumes were soaked for 24 h and dehulled manually. Dehulled legumes mixed with cassava flour at different concentration. Then it was steamed, inoculated with *Neurospora sitophila* and fermented for 48 h. Legumes varieties affected on moisture, pH, hardness, mold growth and absorbance values of red red oncom. Concentration of cassava flour affected on moisture, pH, texture, firmness and absorbance values. Red oncom had best characteristics when it is added by 20% cassava flour. Red oncoms made from peanut, Australian sweet lupine and velvet bean have no significant difference in protein content. Red oncoms made from Australian sweet lupine and velvet bean had good sensory characteristics.

Key words: *Lupinus angustifolius*, *Mucuna pruriens*, red oncom, *Neurospora sitophila*, *cassava*

INTRODUCTION

Traditional fermented beans are typically used as a protein source in many countries. Soy beans are the most common beans species used as raw material for fermented foods. Various microbial species used depending on the type of fermentation media. Currently, interest in the fermented beans also increased due to have health benefits (Amadou *et al*., 2009a, b, 2010; Daker *et al*., 2009; Oboh, 2006; Noroozi *et al*., 2011; Reza *et al*., 2008; Rao *et al*., 2008). Possible use of other types of beans as a raw material for fermented foods should be explored its potential, because they are not only a source of protein but also can be used as a functional food.

Australian sweet lupine (*Lupinus angustifolius*) and velvet beans (*Mucuna pruriens*) are very potential legumes to be developed as foodstuff. Both legumes have higher nutrition value than

soybean and peanut. In Australia, the majority usage of Australian sweet lupine only for feed. Today, the usage of velvet beans only for fertilizer plant, although, some countries use it as foodstuff.

In this research, peanuts and both legumes will be used as raw material for red oncom production. Australian sweet lupine and velvet beans are projected to produce red oncom with high quality of organoleptic and low cost production. To produce of red oncom, another ingredient as a source of carbohydrate for *N. sitophila* and mass booster needed. In this research, cassava flour used as additive substance (Budiwan, 1980), cassava flour was the best additive in production of red oncom. The objective of this research was to find out the effect and correlation between three legumes (peanut, Australia sweet lupine and velvet bean) and three concentrations of cassava flour (5, 20 and 35%) addition to the characteristic, nutrition of values (protein content) and organoleptic quality of red oncom.

MATERIALS AND METHODS

Materials: Materials and tools used in this research are peanut (*Arachis hypogea*), Australian sweet lupine (*L. angustifolius*), velvet bean (*M. pruriens*), cassava flour, banana leaf, filter paper, aquadest, ethanol 70%, autoclave, red oncom former, pH meter, texture analyzer, oven, desiccator, beaker glass, Petri dish, boiling dish, spatula, spectrophotometer and the others materials and tools that used in proximate analysis.

Procedure: Preliminary red oncom preparation was performed to know the interval of cassava flour concentration that used in red oncom production. Concentration of cassava flour that used in pre research are 0, 5, 10, 15, 20, 25, 30 and 35%. Observations in pre research are firmness (scoring 1-5) and flavor from red oncom. Three concentrations of cassava flour have been used for further research.

Red oncom preparation: Three different sources of legumes (peanut, Australian sweet lupine and velvet bean) were used in red oncom production. Additive material used in this research was cassava flour with three different concentrations (5, 20 and 35%).

Velvet beans should be treated to remove the L-dopa (Myhrman, 2002). Scheme of pre treatment process of velvet bean are showed in Fig. 1.

Red oncom production method used in this research is similar with home industry method to produced red oncom with a little bit modification. Red oncom production scheme is shown in Fig. 2.

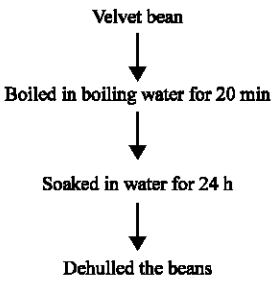

Fig. 1: Velvet bean pre treatment process scheme

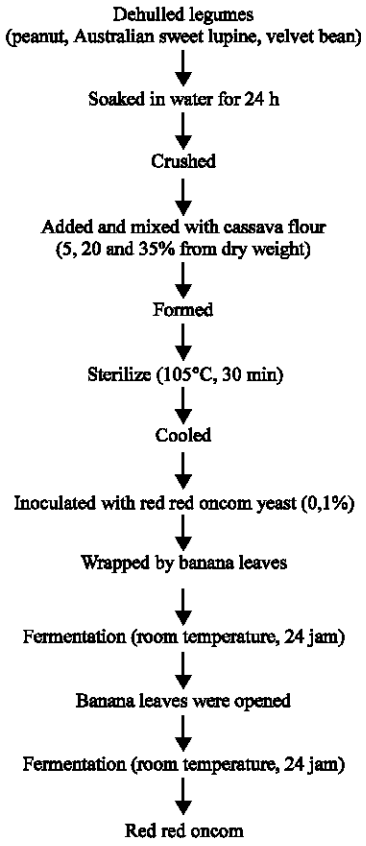

Fig. 2: Scheme of red red oncom production process

Statistical analysis: Red oncom observed every day until six days (day 0, 1, 2, 3, 4 and 5). Analysis conducted in this research includes water content, pH, texture, absorbance number and organoleptic analysis with scoring (firmness, hardness, slime and growth of fungi). Proximate and organoleptic analysis with hedonic were conducted for the best performed red oncom from each legume. The best red oncom was judged from organoleptic analysis by scoring.

RESULTS AND DISCUSSION

Proximate analysis result from raw material: Chemical composition differences from raw material will affect the quality of the red oncom product (Reddy and Pierson, 1999).

Table 1 showed that red oncom produced from peanut has high fat and protein content. Fat content from peanut was suspected will affect to the flavor of red oncom. *Neurospora sitophila* had a high lipolytic activity. *N. sitophila* produced lipase hydrolyzing triacylglycerol into fatty acids (Rahman, 1992). Free fatty acid compounds produced during fermentation affected to the red red oncom flavor (Suliantari and Rahayu, 1990). Lupine red oncom had higher protein content compared to peanut red oncom and velvet red oncom.

Lupine showed the highest protein content (38.14%), compared with peanut and velvet beans with protein content 23.32 and 21.75%, respectively. Protein is an important nutrient compound in red oncom. Raw legumes having high protein content will produce red oncom with high protein content as well. Protein content will affect the characteristics of red oncom. During fermentation, protein will be broke down into simple amino acid compounds affecting to the physical and chemical characteristics of red oncom produced.

Table 1: Raw material proximate analysis result

Parameters	Peanut	Lupine	Velvet bean
Water content (%)	5.76	9.53	11.11
Ash content (%)	2.17	2.50	2.87
Protein content (%)*	23.32	38.14	21.75
Fat content (%)	55.48	8.05	3.39
Carbohydrate content (%)	13.27	41.78	60.88

*Protein (%): N×6.25

Table 2: Water content of red oncom at 2nd day

Type of beans	Addition of cassava flour (% w/w)	Water content (% w/w)
Peanut	5	25.13
	20	27.04
	35	27.99
Lupine	5	65.18
	20	65.38
	35	60.71
Velvet beans	5	44.61
	20	42.37
	35	41.07

Water content analysis: Red oncom is a foodstuff which has high water content. Based on its statistic data, the types of legumes and concentration of cassava will affect to the water content of red oncom as shown in Table 2. Red oncom made from lupine, velvet bean and peanut has different significant water content, with lupine as a highest, followed by velvet bean and peanut. Red oncom with 5% cassava flour addition had water content higher than red oncom with 35% cassava flour addition. Based on statistic, there is an interaction between types of legumes and concentrations of cassava flour to water content of red oncom.

The significant different between type of legumes used and red oncom that produced are effected by the ability of legumes in absorbing water. Lupine was a legume being able to absorb water very easily, therefore, when it was soaked in water, lupine can more water than others. Red oncom with 5% cassava had significant higher water content than red oncom with 35% cassava. Red oncom with lower cassava concentration has higher amount of legumes. Water content in legumes was higher than water content in cassava flour. Based on that fact, red oncom with higher percentage of legumes had higher water content.

Red oncom was a wet food and could release small part of water to the environment. This condition called desorption. Desorption will affect the water content of red oncom during storage. Water content of red oncom have a tend to decline during storage due to this condition. Fermentation could result heat that contribute to the water evaporation as the data shown in Table 2 (Budiwan, 1980).

pH analysis: Red oncom had pH range value between 6.23 until 6.93. Statistically, the differences of legumes and cassava flour concentration affected to the pH value of red oncom as shown in Table 3. Red oncom made from lupine had higher pH than red oncom made from peanut and velvet bean. Red oncom made from peanut had similar pH with red oncom from velvet bean. Red oncom with 5% cassava had higher pH from red oncom with 35% cassava. Statistic showed that there is no interaction between types of legumes with concentration of cassava to pH value of red oncom.

Table 3: pH red oncom at 2nd day

Type of beans	Addition of cassava flour (% w/w)	pH
Peanut	5	6.56
	20	6.50
	35	6.31
Lupine	5	6.93
	20	6.66
	35	6.57
Velvet beans	5	6.41
	20	6.27
	35	6.23

Table 4: Texture of red oncom at 2nd day

Type of beans	Addition of cassava flour (% w/w)	Texture (g cm^{-2})
Peanut	5	1485.7
	20	1543.3
	35	1599.7
Lupine	5	524.6
	20	593.1
	35	818.6
Velvet beans	5	1564.9
	20	1590.9
	35	1590.5

pH value of red oncom made from lupine tend to be higher than others because lupine had highest protein content legume than peanut and velvet bean. Protein could be broke down by proteolytic enzyme from *N. sitophila* became amino acid. Then, amino acids are further degraded to free ammonia. Ammonia was a compound that raised pH value of red oncom.

pH value of red oncom made with 5% cassava tend to be higher than other red oncoms with higher concentrations. Red oncom with lower concentration of cassava had higher concentration of protein. Higher concentration of protein resulted in higher concentration of ammonia which resulted from degradation of protein.

pH value of red oncom will increase during the storage. Fermentation that occurred during storage will increase pH due to accumulation of ammonia that produced from deamination of amino acids resulted from protein degradation by fungi (Suliantari and Rahayu, 1990).

Texture analysis: Red oncom has texture value within range 524.6-1599.7 g cm^{-2}. Statistic showed that differences types of legumes and concentration of cassava flour effected on texture of red oncom that produced as the data shown in Table 4. Red oncom made from velvet bean and peanut had higher texture value significantly than red oncom made from lupine. Red oncom with 35% cassava had higher texture value significantly than red oncom with 5 and 20% cassava. Higher the texture value means harder the red oncom. Statistic showed that there is an interaction between types of legumes and concentration of cassava to texture value of red oncom that produced.

Red oncom made from lupine had the lowest texture value than red oncom made from velvet bean and peanut. Red oncom lupine had the highest water content than the other red oncoms so lupine red oncom had the softest texture that effected to low texture value. Red oncom with 35%

cassava addition had the highest texture value. Cassava could tighten the bond between legumes therefore texture value would get higher when cassava flour concentrations are increased.

During storage, texture value of red oncom would increase. The highest increasing of texture value occurred in the 2nd day. During first 24 h fermentation, water content remained stable because red oncom are wrapped with banana leaves. In the next 24 h, banana leaves were taken out therefore water content would decrease significantly. Higher the water content, texture value would get softer.

Firmness: Firmness is a consistency that occur in red oncom where legumes are not separated one another (compact). Red oncom with good quality had compactness between legumes. In this research, red oncom firmness is measured with scoring method (1 to 5). Higher value means higher firmness of red oncom.

Measurement of red oncom firmness resulted score between 2 to 4 (Table 5). Statistic showed that types of legumes had no effect to red oncom firmness but not so with cassava. Red oncom with 20 and 35% addition of cassava flour had higher firmness significantly than red oncom with 5% cassava (Table 5). Starch granule in cassava flour would absorb water then swallowed and gelatinized (Potter and Hotchkiss, 1995). Gel resulted from, would tighten one and other beans which resulted in firm red oncom. Firmness of red oncom also affected too by fungi mycelium that increased firmness of red oncom.

Hardness: Hardness was defined as the force necessary to attain 75% deformation in our study Hardness defined as susceptible to deformation (Cai *et al*., 1997). In this research, hardness of red oncom is measured with scoring method (between 1 to 5). The higher value showed higher degree of hardness.

Based on this scoring method, hardness of red oncom had range value between 2 to 3.5 (Table 6). Statistic showed types of legumes effected the hardness of red oncom but cassava flour concentration did not (Table 6). Red oncom made from velvet bean had higher hardness significantly than red oncom made from lupine. Red oncom made from lupine had high water content therefore the hardness of this kind of red oncom would get lower. During storage, hardness of red oncom would get higher due to decreasing of water content.

Slime analysis: Appearance of slime in foodstuff showed the deterioration of foodstuff. In this research, amount of slime on red oncom are measured using scoring method (values between 1-5), where higher value means higher amount of slime.

Table 5: Firmness red oncom at 2nd day

Type of beans	Addition of cassava flour (% w/w)	Firmness* (scoring 1 to 5)
Peanut	5	2.0
	20	3.5
	35	4.0
Lupine	5	2.0
	20	3.5
	35	3.5
Velvet beans	5	2.5
	20	3.5
	35	4.0

*The higher value means higher firmness of red oncom

Table 6: Hardness of red oncom at 2nd day

Type of beans	Addition of cassava flour (% w/w)	Hardness (scoring 1 to 5)
Peanut	5	2.0
	20	2.5
	35	3.0
Lupine	5	2.0
	20	2.0
	35	2.0
Velvet beans	5	2.5
	20	2.5
	35	3.5

*The higher value showed higher degree of hardness

Table 7: Amount of slime of red oncom at 2nd day

Type of beans	Addition of cassava flour (% w/w)	Amount of slime (scoring 1 to 5)
Peanut	5	1
	20	1
	35	1
Lupine	5	1
	20	1
	35	1
Velvet beans	5	1
	20	1
	35	1

*The higher value means higher amount of slime

Statistic showed that types of legumes and concentration of cassava had no effect to amount of red oncom produced (Table 7). However, longer times in storage will produce higher slime. Slime was a substance that produced from deterioration of red oncom because of enzyme activity from fungi or other microorganism. Red oncom was a perishable foodstuff, because red oncom had neutral pH value, high water content and protein, makes the microbes could grow easily.

Color absorbance value analysis: Absorbance value from color of *N. sitophila* spore was measured quantitatively by spectrophotometer. Wavelength that used in this measurement was 420 nm. Statistic showed that types of legumes and concentration of cassava affected to the absorbance value of fungi spore in red oncom (Table 8). Red oncom made from lupine had higher absorbance value significantly than red oncom made from peanut which had higher absorbance value significantly than red oncom made from velvet bean. Red oncom with 35% cassava had higher absorbance value significantly than red oncom with 20% cassava which had higher absorbance value significantly than red oncom with 5% cassava.

Red oncom made from lupine had the highest absorbance value because of growth of spores in red oncom made from lupine is higher that red oncom made from peanut and velvet bean. Red oncom with 35% cassava had the highest absorbance value because of abundance of substrates that needed for fungi growth which effected in higher amount of spores. Higher amount of spores in red oncom would effect in higher absorbance value.

Red oncom proximate analysis: Proximate analysis of red oncom was taken from the best red oncom from each legume. Based on this research, the best red red oncom are red oncom made from

Table 8: Absorbance value of red oncom at 2nd day

Type of beans	Addition of cassava flour (% w/w)	Absorbance value
Peanut	5	0.789
	20	0.526
	35	0.563
Lupine	5	0.573
	20	1.551
	35	1.891
Velvet beans	5	0.430
	20	0.393
	35	0.712

Table 9: Proximate Analysis of red oncom made from peanut, lupine and velvet bean

Parameters	Peanut	Lupine	Velvet bean
Water content (%)	39.11	66.11	51.94
Ash content (%)	0.98	0.27	0.57
Protein (%)*	22.77	20.67	21.77
Fat (%)	24.18	0.8	1.89
Carbohydrate (%)	12.96	12.15	23.83

*Protein (%): N×6.25

peanut with 20% cassava, red oncom made from lupine with 20% cassava and red oncom made from velvet bean with 20% cassava, respectively. Table 9 showed proximate analysis result of red oncoms.

Red oncom made from peanut had the highest protein although based on raw material proximate analysis showed that legume with highest protein content was lupine. Red oncom made from lupine had the highest water content so it would reduce the percentage of total solid in sample include protein. Steinkraus *et al.* (1983) mentioned that fermentation process would not effect in total protein values. Fermentation of red oncom did not increase the nutrition value of protein but digestibility and organoleptic value of fermented food are higher than raw material (Van-Veen *et al.*, 1970; Budiwan, 1980).

Red oncom made from peanut had the highest fat content. Based on proximate analysis of raw peanut showed that peanut was legume with highest fat content. During fermentation, triacylglycerides in red oncom would be hydrolyzed by lipase from *N. sitophila* became free fatty acid (Beuchat, 1976; Budiwan, 1980).

Red oncom made from velvet bean had the highest carbohydrate content. Based on proximate analysis of raw peanut showed that peanut was legumes with highest carbohydrate content. During fermentation, there was a slight decreasing in red oncom carbohydrate content. Decreasing of carbohydrate contents in red oncom caused by fungi that needed carbohydrate as source of energy and carbon in cell reconstruction. Fungi needed amount of carbon to grow (Buwalda and Goh, 1982).

Organoleptic: In this research, organoleptic used hedonic method. Based on hedonic method, color of red oncom had range value between 2.59 to 4.91. Based on statistic with Tukey showed that color of red oncom made from peanut and lupine are liker significantly than red oncom made from velvet bean. Red oncom made from peanut and lupine had brownish yellow color that

similar with common red oncom in market. Red oncom made from velvet bean are not susceptible in color because it had uninteresting blackish brown color.

Hedonic method in red oncom aroma had range value between 3.88 to 4.63. Statistic showed that different types of legumes had no significant effect in red oncom aroma.

Hedonic method in red oncom texture had range values between 3.13 to 4.63. Statistic showed that texture of red oncom made from peanut (common red oncom in market) preferably than red oncom made from lupine and velvet bean.

Hedonic method in red oncom taste had range value between 3.28 to 3.94. Statistic showed that types of legumes had no effect to the level of preference of red oncom taste.

CONCLUSION

Differences in sources of raw materials of legumes (peanut, Australian sweet lupine and velvet bean) will effect on water content, pH, texture, hardness, growth of fungi and absorbance value of red oncom produced. Addition of difference concentration of cassava flour (5, 20 and 30%) will effect to the water content, pH, texture, firmness and absorbance values of red oncom.

The best quality of red oncom that produced from each legume is red oncom with 20% cassava addition. Proximate analysis showed that protein content of three kinds of red oncom had no significant differences. Protein content in red oncom made from peanut, lupine and velvet bean was 22.77, 20.67 and 21.77%, respectively. Based on organoleptic test with hedonic method, three kinds of red oncom had no significant differences of preference level in aroma, taste and overall but color and texture from three kinds of red oncom had significant differences of preference level.

Based on protein content analysis and hedonic test from three kinds of red oncom, it can concluded that lupine and velvet bean were very potential as raw material to replace peanut in production of red oncom. Further research is needed to find out the effect of environment, such as temperature and humidity and visibility to produce red oncom in a large scale.

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