Physical Characteristics and Acceptability of The *Keropok* Crackers from Different Starches

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ABSTRACT

***Keropok** crackers made of six different starches (tapioca, maize, arrowroot, cana, **Arenga** sago and **Metroxylon** sago) resulted in different extents of expansion, but this did not correlate with the amylopectin content. Keropok crackers with greater expansion was not neccesarilly more hygroscopic.*

Crispiness acceptability increased with increasing expansion of volume. Higher amylopectin content of the starch gave more acceptable flavor of the cracker.

INTRODUCTION

Keropok cracker is a popular snack in Indonesia, which is flower-like shaped, usually prepared from tapioca starch by frying of the dried steamed starch. After frying, dry gelatinized starch expands manyfolds to a throughly cooked, ready to eat, crispy and porous product.

Structurally, starch is composed of a mixture of linear and branched polymer of α-D-glucose, i.e. amylose and amylopectin, organized into semi-crystalline granules. Amylose is the main component of the crystalline region which is more tightly packed; while amylopectin, the branched portion, is packed in amorphous region. Hence, the amorphous phase may be more readily penetrable by water (French, 1984).

Starch granules of different types are widely varied in strength of intermolecular bonding, and in amount of amylose and amylopectin (Dreher and Berry, 1984). Ratio of amylose: amylopectin is believed to be the determinant factor of starch functional properties (Moore *et al*., 1984).

Physical properties of puffed starch-based snack have been examined by various workers. The extent of expansion and texture of puffed snack are influenced by the amylose: amylopectin ratio. High amylopectin content starches tend to give fragile products of low density. Some amylose is needed to give adequate resistance to breakage and texture that are acceptable. Normally, 50% or more amylopectin is needed for a good-quality product. A starch system containing 5 – 20% amylose was suggested as most suitable for puffer starch-based snack (Fieldberg, 1969; in Matz, 1984).

Crispiness is a salient textural characterisic for most dry starch-based snack food products. A major cause of snack food product rejection by consumers is absorption of moisture (Nielsen, 1979; in Katz and Labuza, 1981). Water affects the crispiness of dry snack foods by plasticizing and softening the starch/protein matrix which alters mechanical strength of the product (Katz and Labuza, 1981). Similar behavior may be exist in *keropok* cracker. The extent of expansion may be related to crispiness as well as hygroscopicity.

Various types of starch are available in the market and possibly potential to produce quality starch based snack similar to *keropok* cracker. Though, only tapioca starch is usually used commercially as raw material, probably because it is the cheapest and always available in reasonable quantity. Limited studies have attempted to assess *keropok* cracker characteristics. More research works have been conducted on flat fish crackers (Mohamed, *et al*, 1989; Yu, 1991a; 1991b; Yu *et al*, 1981), which revealed that linear expansion decreased with increasing non-starch components, and basically expressed that linear expansion was positively correlated to the amylopectin content.

The objective of this study was to compare the extent of expansion, higroscopicity, and hedonic acceptability of *keropok* crackers from various starches.

MATERIALS AND METHODS

Starches

Six commercial samples of starch were used in this experiment; i.e. tapioca, maize, arrowroot, cana, *Arenga* sago and *Metroxylon* sago starches. They are analyzed for moisture by drying in an oven at 110°C according to AOAC (1970). Amylose was determined by iodine binding capacity as described by Juliano (1971). The amylopectin content of the starch was calculated by difference.

Keropok Crackers

Viscoelastic dough-like mixture was made by adding boiling water (600 gr) containing pounded garlic (40 gr), mono sodium glutamate (5 gr), canned mackerel (6.2 gr), cane sugar (40 gr), little by little to the starch (1000 gr). The mixture containing semi-gelatinized starch was then fed into a simple extruder to flow down worm-like stuff, shaped and cut manually, steamed for 15 minutes and dried at 50°C using a cabinet dryer to give final moisture content of 8 – 9%. The dried raw *keropok* cracker having a thickness of 3 – 4 mm was then fried in two phases at 170°C until floating, and at 250°C to fully expand.

Keropok crackers were measured for the extent of expansion, and the data presented as percentage of the additional volume of the finished product from the original volume. In this study, hygroscopic property of *keropok* cracker was expressed as a tendency to increase in weight in a controlled humid atmosphere; it was determined by keeping fresh fried *keropok* crackers over a saturated NaCl solution containing the crystaline salt in air tight capped flask for 20 hours. The equilibrium relative humidity of the air inside the flask, i.e. 75%, was considered adequate to simulate the average value of daily air condition of the environment of local area. The sample was taken and weighed every two hours during storages.

Hedonic acceptabilities relating to crispiness intensity, flavor characteristic, and overall hedonic values were tested by 20 panelists based on the method of Larmond (1977). At each testing session to the judges were presented a series of samples to evaluate the acceptability by scoring 1 to 9. The highest score (9) was given to the sample representing the most acceptable and the lowest score (1) was indicating the most unacceptable sensation.

RESULTS AND DISCUSSION

Moisture, amylose and amylopectin contents of the individual starch are presented in Table 1. The extent of *keropok* cracker expansion after frying varied with different starch types as shown in Table 2. *Keropok* cracker made from tapioca which contained the highest amylopectin (Table 1) showed markedly greatest expansion. Yet, for other samples of higher amylopectin level did not always give greater expansion of the finished product (Table 1 & 2). This may be due to the difference in compactness of the raw *keropok* cracker from different types of starch used. Each starch from different botanical origin may have different gelatinization temperature, so that heat treatment during preparation resulted in different degree of gelatinization, and consequently resulted in different compactness of the retrograded starch, and finally gave different extent of expansion after frying. Earlier work by Siaw, *et al* (1985) reported that ungelatinized or semi-gelatinized starch granules would result in poor expansion characteristics.

Table 1. **Moisture, amylose and amylopectin contents of various starches**

Starch tyep	Moisture % (w/w)	Amylose % (w/w)	Amylopectin % (w/w)
Tapioca	16.4	17.6	82.4
Areanga sago	18.1	21.3	78.7
Maize	16.3	22.2	77.8
Metroxylon sago	21.7	24.0	76.0
Arrowroot	18.8	26.2	73.8
Cana	24.3	27.4	72.6

Table 2. **Extent of expansion of *keropok* crackers from different types of starch**

Starch Type	Extent of expansion (%)
Tapioca	178.0[a]
Arenga sago	58.4[c]
Maize	49.1[cd]
Metoxylon sago	79.0[b]
Arrowroot	39.0[d]
Cana	43.6[d]

Means followed by the same letter are not significantly different from each other (P > 0.05)

In accordance with the fact mentioned above, various research workers (Chandrasekhar and Chattopadhay 1991) have studied the different paddy varietal characteristics that effected expansion of puffed rice, e. g. total amylose, hot water insoluble amylose, and protein content; however, contradiction exist among their reported findings which call for further investigation.

Tendency of fried *keropok* crackers to pick up moisture during storage is illustrated in Figure 1. About 6% increase in weight had affected the crispiness; the *keropok* crackers became tougher gradually. Loss of crispiness was observed as the weight gain reached 9%.

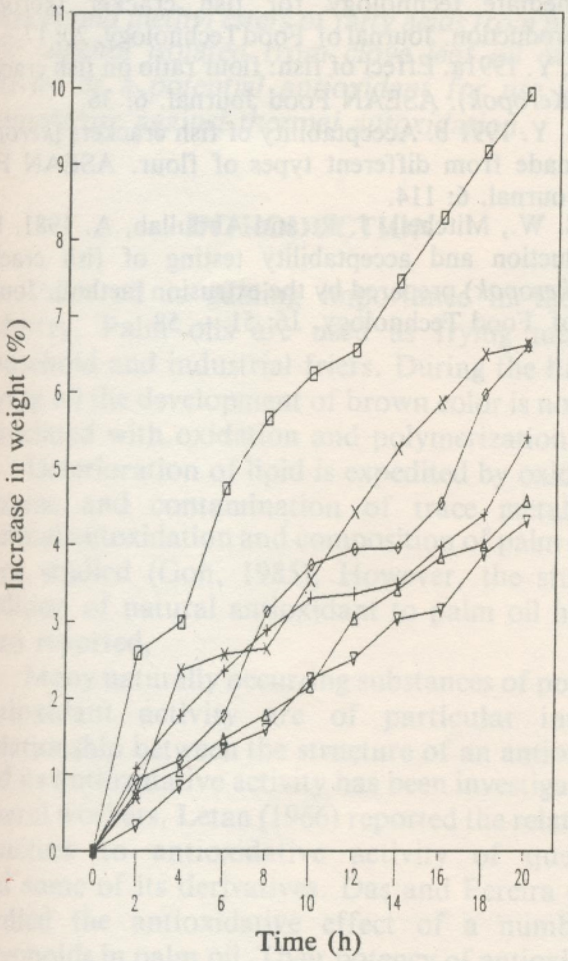

Figure 1. **Increase in weight of *keropok* crackers from tapioca ([]), arrowroot (X), *Arenga* sago (◊), *Metroxylon* sago (+), maize (Δ), and cana (V) starches during storage**

Theoretically, greater expansion has wider surface area of fried *keropok* cracker with a consequent effect of being easier to absorb moisture from the surrounding air. However, no such relation was found between hygroscopicity (Figure 1) and expansion data (Table 1). These different behavior might be due to difference in physically trapping of the frying oil and chemically binding of lipid resulted from hydrolysis of the oil occuring during frying. Earlier study on oil-heated starch (Haryadi, 1983) reported that starch was able to bind lipid during frying.

Greater expansion of *keropok* cracker gave more acceptable crispiness of the product (Table 2 and Table 3). There was a tendency that increase in amylopectin content resulted in increased flavor acceptability (Table 1 and Table 2). The reason might be that starch containing higher level of amylopectin trapped higher oil bearing flavoring agents. The highest overall hedonic values was given to the sample made from tapioca starch.

Table 3. **Hedonic values for *keropok* crackers made from various starches**

Starch Type	Crispiness	Flavour	Overall hedonic acceptability
Tapioca	7.8^a	7.2^p	7.5
Arenga sago	3.8^b	5.4^q	4.7^y
Maize	3.5^b	5.6^q	4.8^y
Metroxylon sago	4.2^b	5.2^q	4.2^y
Arrowroot	2.3^c	4.5^r	3.2^z
Cana	2.4^c	3.6^r	2.9^z

Means at the same colum followed by the same letter are not significantly different from each other ($P > 0.05$)

CONCLUSIONS

Various starches gave different extent of expansion of the *keropok* crackers produced, but no positive relation to amylopectin level was found. Hygroscopicity did not depend on the extent of volume expansion.

Greater expansion gave higher crispiness acceptability. Increase in amylopectin content resulted in increased flavor acceptability.

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