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CHALLENGES IN FOOD SAFETY:

science - based approach for food safety management



editor:

Ratih Dewanti-Hariyadi

Lilis Nuraida

Desty Gitapратиwi

Nelis Immaningsih

Purwiyatno Hariyadi



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Southeast Asian Food and Agricultural Science and Technology (SEAFAST) Center
Bogor Agricultural University

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'Current Issues and Challenges in Food Safety:
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Editor:

Ratih Dewanti-Hariyadi
Lilis Nuraida
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Nelis Immaningsih
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Southeast Asian Food & Agricultural Science & Technology (SEAFAST) Center,
Bogor Agricultural University
Kampus IPB Darmaga, Bogor 16680
www.seafast.ipb.ac.id

EFFECT OF TIME-TEMPERATURE AND AMYLOSE CONTENT OF RICE ON THE COLOR AND TEXTURE OF RICE-BASED EMERGENCY CANNED FOOD

Elvira Syamsir^{1,2}, Maggy T. Suhartono² and Sherly Valentina²

¹SEAFast Center and ²Dept. of Food Science and Technology, Bogor Agricultural University

ABSTRACT

Rice-Based Emergency Canned Food (RB-ECF) was made from rice and chicken as the main ingredients. The product was made to meet the required daily energy level of 2100 kcal to be able to be consumed directly in emergency condition. The product was packed in 307 x 113 silver enamel can and canned in retort at 250°F (Tr) with CUT = 21 minutes. The product's weight was 200 gram per can with a total energy value of 639.42 kcal. The total energy value was calculated from fat (49.63%), protein (11.26%), and carbohydrate (39.11%).

Rice with different amylose content (19.50% -Cisadane, 23.88% -IR 64 and 28.24% -IR 42) were used to make RB-ECF. Thermal processing was carried out by different time-temperature schedules to achieve 15 and 20 minutes sterilized value (Fo). Objective analysis of the products showed that amylose content and Fo value affected the color and texture of the products.

INTRODUCTION

Emergency food product is a processed food for emergency situations, which can be consumed directly and meet the daily nutritional needs. The main characteristics desired are good palatability, safe to consume, easy to distribute, and contain sufficient nutrients daily needs. Ideally, contribution of calories from protein, fat and carbohydrate respectively is 10-15%, 35-45% and 40-50% (Zoumas et al, 2002).

Rice (*Oryza sativa*) is consumed daily because it is the staple food for most Indonesian people, thus development of a rice-based emergency canned food (RB-ECF) is appropriate. Starch is the major

component of rice and consequently play an important role in food product quality. Functional properties of starch have considerable effect on the quality of starch-based product (Bhattacharyya et al, 2004; Kaur et al, 2005). Processing time needed to achieve a certain sterilized value at retort commercial sterilization will significantly change the color and texture of food canned. Retort sterilization will normally disrupt starch structure which leads to a soft, mushy texture not well-regarded by consumers. Past research showed that apparent amylose content was the best overall indicator for predicting canning stability (Patindol et al, 2007).

The objective of this study was to observe the effect of different time-temperature schedules to achieve sterilized value (F_0) and amylose content of rice on the color and texture of the RB-ECF.

MATERIAL AND METHODS

Rice with different amylose content (Cisadane, IR 64 and IR 42) and other ingredients were procured from Pasar Bogor. The starch and amylose content of rice was determined by DNS method and iodometry method respectively (both as described by Apriyantono et al, 1989); and amylopectin content obtained as the difference of starch content with amylose content (Table 1).

RB-ECF was prepared as shown in Figure 1, with rice and chicken as the main ingredients. Product was canned in silver enamel can, 307 x 113 in size. Weight of product was 200 gram per can with the total energy value was 639.42 kcal. Distribution energy from fat, protein and carbohydrate were 49.63, 11.26 and 39.11%. Thermal processing was carried out by different time-temperature schedules at 250°F to achieve 15 and 20 minutes sterilized value (F_0) was shown in Table 2.

Color analysis of product was made using chromameter (Minolta CR-200) for L value, a value and b value. Texture profile analysis was performed at room temperature by using TA-XT2 texture analyzer. Hardness, springiness, cohesiveness, gumminess, chewiness and adhesiveness were determined.

Table 1. Starch, amylose and amylopectin content from several types of rice (g/100 g)

Type of rice	Starch	Amylose	Amylopectin	Classified of amylose content*
Cisadane	85.85	19.50	66.35	Low (2-19% amylose)
IR 64	83.46	23.88	59.58	Intermediate (20-25% amylose)
IR 42	85.08	28.24	56.84	High (25-33% amylose)

* IRRI, 2009

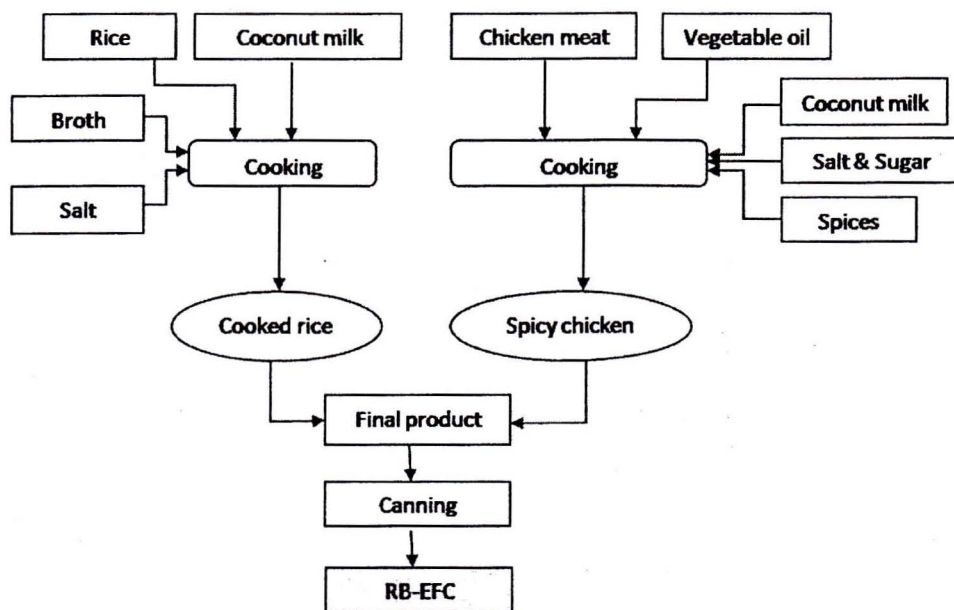


Figure 1. Preparation of Rice-Based Emergency Food Canned (RB-EFC)

Table 2. Processing time (minutes)

Type of rice	Processed time (minutes)	
	F ₀ = 15	F ₀ = 20
Cisadane	51	58
IR 64	49	57
IR 42	50	56

Come Up Time (CUT) = 21 menit

RESULTS AND DISCUSSION

Color Properties

RB-ECF color was significantly affected by amylose content of rice and processing time (Figure 2-3). Amylose content affected the brightness value (L value) and a-value, but they insignificantly affected b-value of RB-ECF. L-value of product increased with increasing amylose content, and blueness (-a value) were vice versa. According to Hariyadi (2006), rice with high amylose tend to absorb more water and expand bigger when they were cooked and made their color becomes brighter.

Processing time affected the color of product. This result is in accord with Bhattacharya (1996), who found that pressure and steaming time had marked effects on product's Hunter color. The decrease of the brightness was more pronounced at longer processing time. Severe cooking had less effect on yellowness (b value) than on blueness (-a value). The color change has been hypothesized to be caused mainly by non enzymic browning of the Maillard reactions (Lamberts et al, 2006).

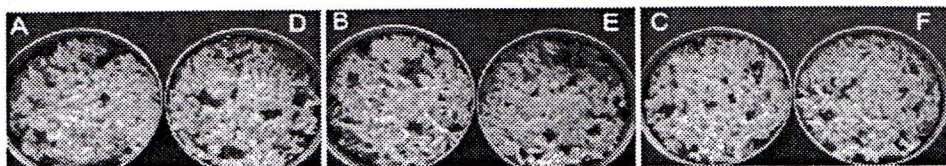


Figure 2. Visualization of RB-ECF (A: low amylose – 15 minutes (Fo); B: intermediate amylose – 15 minutes; C: high amylose – 15 minutes; D: low amylose – 20 minutes; E: intermediate amylose – 20 minutes; F: high amylose – 20 minutes)

Texture Properties

Hardness and stickiness is the most important physical properties of RB-ECF among all the physical properties, which makes significant influences in increasing consumer acceptability. Amylose content strongly influences hardness and stickiness (adhesiveness) of rice product. Figure 4 showed the hardness and gumminess of product increased as amylose content increased, were adhesiveness vice versa. Rice with a high amylose content tends to cook firm and

dry, whereas rice with a intermediate amylose content tends to be softer and stickier and rice with a low amylose content is quite soft and sticky. This result agree with Bhattacharya et al (1999) that concluded that apparent amylose content was highly correlated with rice noodle hardness, gumminess, and chewiness. This result is also in line with Ong and Blanshard (2002) that found that hard cooking rice tended to have a higher amylose content (or amylose:amylopectin ratio) and more longer chain amylopectin than soft cooking rice, which feature is thought to encourage more extensive intra and/or inter molecular interactions with other components in rice grain, such as protein, lipid and non-starch polysaccharides and results in a firmer texture. Slightly decreasing of hardness and increasing of stickiness were found when processing time was increased. It was probably due to deformation of the grain and exposed endosperm after grain splitting sharply changed hardness and stickiness values. Increasing time sterilisation also induced high gelatinization, wich resulted in a softer and stickier texture in the product.

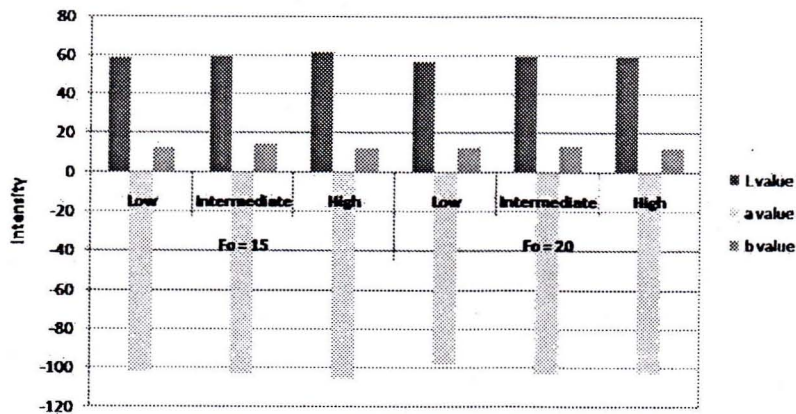


Figure 3. Effect of amylose amylose content of rice and time processing (Fo) on color of RB-ECF

The springiness value of product varied from 0.901 until 1.006 mm, where amylose content made a small variation in springiness. This results were in agreement with a previous report by Cheng *et al.* (2005). Interaction of amylose content and processing time affected

springiness value differently. At the F_0 was 15 minutes, the springiness of product increased as amylose content increased. The springiness value decreased with increasing amylose content at the longer time processing ($F_0 = 20$ minutes). The different of amylopectin structures may explain why rices can have different springiness properties.

Amylose content had positive impact and strongly influenced the hardness and stickiness of rice product. Figure 4 showed the hardness and gumminess of product increased as amylose content increased. Chewiness refers to number of chews required to masticate product before it was suitable for swallowing or the amount of work required to chew the sample for sensory evaluation. It was observed that amylose content had main effects on chewiness. Chewiness increased with the increase in amylose content, but not affected by processing time (Figure 4).

CONCLUSION

The results demonstrate that time scheduling (processing time) of thermal processed and amylose content of rice distinctly affected color and texture of RB-ECF. These treatment affected the brightness value (L value) and a-value, but they insignificantly affected b-value of product. At product texture, amylose content strongly influences hardness, gumminess, chewiness and stickiness (adhesiveness) whereas time scheduling affected hardness, gumminess and adhesiveness values.

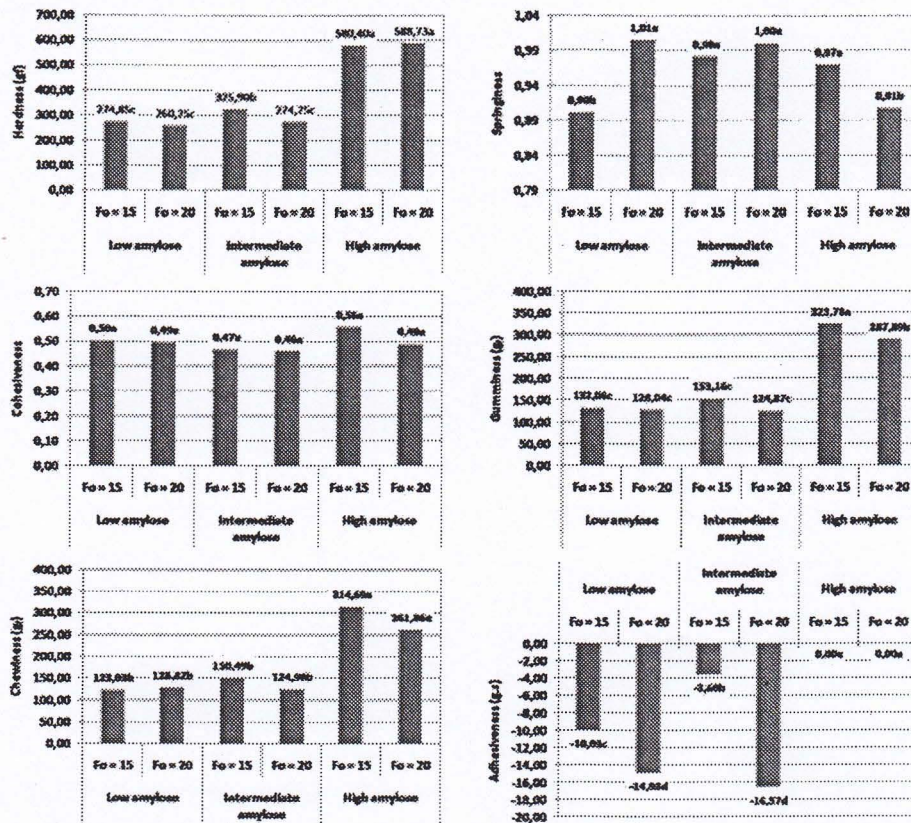


Figure 4. Effect of amylose content of rice and time processing (Fo) on texture of RB-ECF (hardness, springiness, cohesiveness, gumminess, chewiness and adhesiveness/stickiness)

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