Diversification of processed cocoa using coconut to increase the added value

J Langkong, R Latief, A N F Rahman, A Dirpan, M T Sapsal, I Kamaruddin and Marselia

Department of Agricultural Technology, Faculty of Agriculture, Hasanuddin University, Makassar, Indonesia

E-mail: jumriah_langkong@yahoo.com

Abstract. Chocolate bar is one of secondary product of cocoa beans which are ready to consume. The aim of this research is to know the effect of shredded copra addition as a filler of chocolate bar. The method of this research started from the processing of beans into fats and cocoa powder, the making of shredded copra as a filler, and the making of chocolate bar. The evaluation done based on carbohydrate content, moisture content, ash content, fat content, fat blooming, and organoleptic in terms of color, odor, taste, and texture. The design of research used was completely randomized design in 3 repetition. Sample used is shredded copra (A1 = 6%, A2 = 9%, and A3 = 12%). The results shows that addition of shredded copra is significant at the 5% level of ash content and fat content. While organoleptic test shows that A1 (addition of 6% shredded copra) is most preferred by panellist in terms of color and texture, while A3 (addition of 12% shredded copra) is most preferred by panellist in terms of aroma and taste parameter.

1. Introduction
Cocoa commodity can be processed into a derivative products in the community. As an outline, cocoa beans can be processed into cocoa fat, cocoa powder, and candy or chocolate [1]. Meanwhile, cocoa fat has a different harshness level at room temperature based on area where it grows [2]. Chocolate bar is secondary processed product from cocoa beans which is practical and ready to consume. Various kinds of chocolate bar can be filled by different filler material. The material used for chocolate can affect the appearance and chocolate quality that produced. Generally, chocolate made with or without filler. Almond and cashew nut usually used as filler for chocolate bar. Therefore, producing variant filler for chocolate bar is necessary to meet consumer demands, such as coconut.

Coconut is plantation products that contains some macronutrient and micronutrient. Coconut is easy to find and cheap, moreover Indonesia is a tropical country that easy to grow coconut. Coconut water and coconut are generally utilized in daily life. Coconut contains fat and protein that gives savory sensation. Other than that, coconut is easy to rotten. Therefore, coconut often used as oil or coconut milk. Along with abundant raw material and growing technology of coconut processing, provides opportunity to product diversification. Coconut diversification not yet fully implemented in Indonesia [3]. Meanwhile, there are some food processing technology that can make coconut have a long shelf life, such as drying process.

Drying process of coconut gives added value and produce a new product. This is caused by moisture content of coconut is decreased so it affects the shelf life. Drying process gives good sensory
quality, typical odor of coconut, and produce savory sensation. Substitution of shredded copra as filler can increase the added value such as volume, taste, and reduce formulation cost. Size and mass variation of filler affect the mechanical properties, physical properties, and organoleptic. This is influenced by chocolate as a matrix filled by particle like filler. Pressure of dough can be affected by increase in the amount of chocolate bar material, because chocolate bar quality also depend on mechanical and physical properties. Based on the description, this research done to utilize coconut as a filler material of chocolate bar with other added materials so it’s produce a good quality of chocolate bar.

2. Methods

2.1. Materials and Tools

Materials used are cocoa powder, cocoa fat, soy lecithin, shredded copra, salt, Sodium bicarbonate, skimmed milk, refined sugar, NaCl, plastic, tissue, aluminium foil, phenolphthalein indicator, NaOH, aquadest, alcohol 96%, and some water.

Tools used are roasting machine, pressed machine, bowl, analytical scales, mortar and pestle, thermometer, grater, blower, pipette bulb, knife, stove, spatula, 100 mesh testing sieve, spoon, refrigerator, petri dish, hot plate, and dessicator.

2.2. Method

20% of cocoa fat is heated at 50°C for 15 minutes until get some liquid cocoa fat, then the temperature decreased until 22°C for 8 minutes. 20% of cocoa powder, 20% of skim milk, 39% of sugar, and 0.1% of lecithin is mixed evenly, and conching it for 24 hours. Tempering is done at 45°C, then the temperature decreased until 25°C and increased until 40°C. Shredded copra is added according to the treatment and mold it at 35°C. Chocolate be refrigerated at 10°C until chocolate emulsion is solid, and organoleptic test (texture, color, aroma), proximate analysis is done. Treatment of this research are formulation of shredded copra in percentage such as A1 = 6%, A2 = 9%, A3 = 12%.

2.2.1. The making of shredded copra. Cocoa beans used is fermented cocoa from Tana Toraja. Cocoa beans was dried until 8-10% of moisture content. Cocoa beans are cleaned, sorted, and roasted at 1150°C for 30 minutes to obtain the cocoa beans. Cocoa beans is re-roasted at 1150°C for 30 minutes. Then, cocoa beans mashed up into a cocoa paste. Cocoa paste pressed to separate the fat and powder. Cocoa powder is re-mashed up using 100 mesh testing sieve.

3. Result and discussion

3.1. Moisture content

Based on moisture content analysis, chocolate bar with 6% of shredded copra (A1) has 1.65% of moisture content, chocolate bar with 6% of shredded copra (A2) has 1.7% of moisture content, and chocolate bar with 12% of shredded copra (A3) has 1.7% of moisture content.

Analysis of variance shows that dried coconut added to chocolate bar is not significant to the moisture content. This is due to the amount of shredded copra added that has little interval. Other than that, the filler material has low of initial moisture content. Low moisture content of shredded copra influenced by a long time of drying process. This is caused by that the ability of the material to release water from its surface will increase along with increases of dryer temperature and a longer time of drying process, with the result that moisture content is getting lower.
3.2. Ash content

Based on ash content analysis, chocolate bar with 12% of shredded copra (A3) is the highest ash content of 2.0%, meanwhile chocolate bar with 9% of shredded copra (A2) has 1.95% of ash content, and chocolate bar with 6% of shredded copra (A1) is the lowest ash content of 1.32%.

Analysis of variance shows that ash content of chocolate bar is significant at the 5% level so that Duncan test is carried out. Duncan test shows that sample with 6% of shredded copra (A1) is significant with A2 and A3, this is due to coconut that have gone through drying process. More meat is added, the ash content is increases. In accordance to Susanto (2011) research, that ash content will increase along with increasing of additional ingredients substitute [4].

---

**Figure 1.** Chocolate bar with shredded copra added percentage to moisture content

**Figure 2.** Chocolate bar with shredded copra added percentage to ash content
3.3. **Protein content**

Based on protein content analysis, chocolate bar with 6% of shredded copra (A1) has 7.2% of protein content, meanwhile chocolate bar with 9% of shredded copra (A2) has 6.82% of protein content, and chocolate bar with 12% of shredded copra (A3) has 6.48% of protein content.

Analysis of variance shows that dried coconut added to chocolate bar is not significant to the protein content. This is due to the protein content of chocolate bar dough. The increasing of shredded copra causes chocolate paste dough mass will decreases, this is due to decreases of protein content. Chocolate bar dough contains cocoa powder, cocoa fat, sugar, full cream milk powder, and lecithin. That material contains high of protein sources, so that Other than that, the more additions of material causes the protein increases too. The results supported by a statement by Hidayat *et al.* (2006), that milk contains main protein called casein as much as 80% of total protein [5]. This is due to a statement by Ketaren (1986), that the amount of total protein in chocolate bar will increases along to lecithin concentration [6].

![Figure 3. Chocolate bar with shredded copra added percentage to protein content](image)

3.4. **Fat content**

Based on fat content analysis, chocolate bar with 6% of shredded copra (A1) is the highest fat content of 13.29%, meanwhile chocolate bar with 9% of shredded copra (A2) has 12.59% of fat content, and chocolate bar with 12% of shredded copra (A3) is the lowest fat content of 10.3%.

Analysis of variance shows that fat content of chocolate bar with shredded copra is significant at the 5% level so that Duncan test is carried out. Duncan test shows that sample with 6% of shredded copra (A1) is significant with A2 and A3, this is due to dough of cocoa paste. Increasing of shredded copra added causes dough mass decreases. Chocolate bar dough consists of cocoa fat, cocoa powder, lecithin, sugar, and milk. Some ingredients that give effect to fat content of chocolate bar are milk powder and cocoa fat. So that, the higher percentage of milk powder and cocoa fat, so fat content of chocolate bar will increases too. This is caused by that milk powder contains some fat so there will be increase in fat content if substituted. Besides milk powder, cocoa fat gives effect to fat content of chocolate.
Based on carbohydrate content analysis, chocolate bar with 12% of shredded copra (A3) is the highest carbohydrate content of 79.57%, meanwhile chocolate bar with 9% of shredded copra (A2) has 76.99% of carbohydrate content, and chocolate bar with 6% of shredded copra (A1) is the lowest fat content of 76.6%.

Analysis of variance shows that fat content of chocolate bar with shredded copra is significant at the 5% level so that Duncan test is carried out. Duncan test shows that sample with 6% of shredded copra (A1) is significant with A3, this is due to shredded copra added. Carbohydrate content will increase along with more percentage of shredded copra added. Still, carbohydrate content influenced by the proportion of moisture content, ash content, protein content, and fat content of shredded copra, meanwhile, if the proportion was smaller, so the carbohydrate content is greater. In accordance to Muchtadi and Ayustaningwario (2010) statement, that foods contains compound like carbohydrate, protein, and mineral in high concentration by reducing the moisture content. Meanwhile, vitamins and pigments will damaged and reduced [7].
3.6. Organoleptic test

3.6.1. Color. Based on organoleptic test of color, chocolate bar with 6% of shredded copra (A1) get liked from panelist with 4.12, chocolate bar with 9% of shredded copra (A2) almost get liked from panelist with 3.96, and chocolate bar with 12% of shredded copra (A3) get liked from panelist with 4.05. Based on research result, that chocolate bar with 6% of shredded copra (A1) get the higher levels of like in color. This is caused by coconut that used as filler ingredients of chocolate bar. Coconut that have gone through heating causes color changes from white to tawny. This change is caused by nonenzymatic reaction referred to Maillard reaction. Maillard reaction occur when amino acid and sugar is decreases, protein or other nitrogen-containing compounds is heated jointly. In accordance to Ophart (2003) statement, that Maillard reaction occur to reducing sugar and primary amine group reaction [8].

![Figure 6. Chocolate bar with shredded copra added percentage to color](image)

3.6.2. Odor. Based on organoleptic test of odor, chocolate bar with 6% of shredded copra (A1) almost get liked by panelist with 3.81, chocolate bar with 9% of shredded copra (A2) almost get liked by panelist with 3.83, and chocolate bar with 12% of shredded copra (A3) almost get liked too by panelist with 3.92. Based on research result, that more high the percentage of shredded copra, panelist liking level is higher too. 12% of shredded copra (A3) is the highest liking level of panelist and the lowest is A1 with 6% of shredded copra, because coconut contains aromatic compound such as 2-acetyl-1-pyrroline (2-AP), and classified as pyrol compound. Typically odor of coconut is increase if addition of coconut is more. In accordance to Jaroonchon et al. (2017) statement, that strong odor comes from 2-AP form and mostly in coconut [9].
3.6.3. Texture. Based on organoleptic test of texture, chocolate bar with 6% of shredded copra (A1) almost get liked by panelist with 4.03%, compared with chocolate bar with 9% of shredded copra (A2) in 3.6%, and chocolate bar with 12% of shredded copra (A3) in 3.68%. Texture of A1 get liked because of the size, shape, and volume of chocolate bar filler. Coconut has its own pressure, so more coconut added, it will produce great compressive strength. Deformation will decreased along with increasing of particle amount, because load that receive by matrix will be forwarded by particle as a brace. In accordance to Bolenz et al (2011), that particle size distribution is the determinant of flow (rheological), affect the viscosity and texture [10]. This statement reinforced by Gapsari and Putu (2010), that mechanical behavior of composite materials on static loads in the form of tensile and bending loads depends on the shape and size of the filler. In the bond between matrix and filler, filler volume fraction, aspect ratio of filler is the most important factor to determine the strength of the matrix [11]. Grain size and volume fraction of filler composite materials will affect the mechanical properties of the composite material.

![Figure 7. Chocolate bar with shredded copra added percentage to odor](image1.png)

![Figure 8. Chocolate bar with shredded copra added percentage to texture](image2.png)
3.6.4. Taste. Based on organoleptic test of taste, chocolate bar with 6% of shredded copra (A1) almost get liked by panelist with 3.85, chocolate bar with 9% of shredded copra (A2) get liked by panelist with 4.03, chocolate bar with 12% of shredded copra (A3) get liked by panelist with 4.44. Based on research result, that chocolate bar with 12% of shredded copra (A3) get the higher levels of like in taste, and the lowest is 6% of shredded copra. This is shows that panelist likes shredded copra if they were added. This is influenced by protein and fat content of chocolate bar. In accordance to Winarno (1992), that the cause of good taste determined by the amount of protein and fat of the product [12]. The statement reinforced by Sudarmadji et al (1997), that protein and fat highly correlated to consumer judgement especially for taste [13].

![Figure 9. Chocolate bar with shredded copra added percentage to taste](image)

3.7 Fat Blooming
Blooming marked by appearance of white spot in chocolate. This symptoms is not desirable because it makes bad appearance of chocolate bar. This analysis is done by storing chocolate bar about 21 days at room temperature. Based on fat blooming result test, chocolate bar with 9% of shredded copra (A2) has fat blooming on 21st day. Meanwhile there is no fat blooming in A1 and A3. Fat blooming causes of chocolate ingredients such as fat percentage, tempering, and storage condition. In accordance to Faridah (2008) statement, that chocolate will not have fat blooming if the fat was stable [14]. To prevent fat blooming, it was necessary to do good tempering and emulsifier added. Tempering is done to get stable fat. Bad Tempering will lead to bad color (opaque) of chocolate, chocolate stick to the mold, and there is blooming causes by the fat crystal is not stable.

5. Conclusion
The statistic results presented in this research shows that addition of shredded copra is affect on 5% level to the enhancement of fat, ash, and carbohydrate content, but not significant to enhancement of moisture and protein content. The results presented in this research shows that addition of shredded copra is significant at the 5% level of ash content and fat content. While organoleptic test shows that A1 (addition of 6% shredded copra) is most preferred by panellist in terms of color and texture, while A3 (addition of 12% shredded copra) is most preferred by panellist in terms of aroma and taste parameter.
References

[1] Wahyudi T, Pangabean T R and Pujianto P 2008 Panduan Lengkap Kakao Manajemen Agribisnis dari Hulu hingga Hilir *Penebar Swadaya, Jakarta* 364

[2] Lipp e M and Anklam E 1998 Review of cocoa butter and alternative fats for use in chocolate—part A. Compositional data *Food Chem.* **62** 73–97

[3] Wirakartakusumah M A, Muchtadi T R, Syarif A M, Rokhani S and Ketaren S 1993 A groindustri kelapa Dalam Prosiding Konferensi Nasional Kelapa III, Buku III *Seri Pengembangan Pusat Penelit. dan Pengemb. Tanam. Ind. Bogor* 205–20

[4] Susanto D and Susanto D 2012 Potensi Bekatul Sebagai Sumber Antioksidan dalam Produk Selai Kacang

[5] Hidayat N, Padaga M C and Suhartini S 2006 Mikrobiologi industri *Penerbit Andi. Yogyakarta*

[6] Ketaren S 1986 Pengantar teknologi minyak dan lemak pangan

[7] Muchtadi T R and Ayustaningwarno F 2010 Teknologi proses pengolahan pangan *Alf. Bandung* **246**

[8] Ophart C E 2003 Virtual Chembook, Elmhurst

[9] Jaroonchon N, Krisanapook K and Imsabai W 2017 The development of 2 acetyl-1-pyrroline (2-AP) in Thai aromatic coconut. *Songklanakarin J. Sci. Technol.* **39** 139–47

[10] Bolenz S, Holm M and Langkrär C 2014 Improving particle size distribution and flow properties of milk chocolate produced by ball mill and blending *Eur. Food Res. Technol.* **238** 139–47

[11] Gapsari F and Setyarini P H 2012 Pengaruh Fraksi Volume terhadap Kekuatan Tarik dan Lentur Komposit Resin Berpenguat Serbuk Kayu *Rekayasa Mesin* **1** 59–64

[12] Winarno F G 1992 *Kimia Pangan dan Gizi* (jakarta: PT. Gramedia Pustaka Utama)

[13] Sudarmadji S 1997 Prosedur Analisis untuk Bahan Pangan dan Pertanian

[14] Faridah D N, Kusnandar F, Herawati D, Kusumaningrum H D, Wulandari N and Indrasti D 2008 Penuntun Praktikum Analisis Pangan *Fak. Teknol. Pertanian, Inst. Pertan. Bogor*