

Utilization of Chemical Compounds in Cocoa Peel Waste as a Healthy Drink

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Abstract—West Sumatra Province is one of the largest cocoa pod (*Theobroma cacao* L) producing areas in Indonesia. It was recorded that from 2004 to 2007 the area of cocoa plantations increased by around 33,340 ha from 13,197 ha to 46,627 ha. As long as only the seeds are used from cocoa pods, while the skin is only used as animal feed or compost and the rest is left to rot around the plantation area. Whereas cocoa skin waste contains chemical compounds that are beneficial to the body. Based on XRF analysis, it was found that the cocoa husk contained the most K and Ca elements. K is important cation in the intracellular fluid that plays a role in balance pH and osmolality and the element Ca is an essential nutrient needed for various body functions. Cocoa peel contains polysaccharides (hemicellulose 36.23% and cellulose 1.14%) and lignin around 20-27.95% and contains flavonoids which can act as antioxidants against free radicals. Free radicals that enter the body cause cell damage that results in the emergence of several diseases such as heart disease, Alzheimer's disease, cancer, and other diseases. Therefore, cocoa shell waste is very suitable to be processed into natural health drinks because of the many chemical compounds in it.

Keywords—chemical compounds, cocoa peel, antioxidants, health drinks

I. INTRODUCTION

75% of the fresh cocoa pod is the skin [1]. Cocoa pods consist of 73,73% cacao pod, 2,0% placenta and 24,2% seeds [2]. In terms of content, cocoa pods contain 11.71% crude protein, 20.79% crude fiber, 11.80% fat, and 34.90% BETN [3]. Fitriana's research (2011) states that the results of the chemical analysis of cocoa skin have crude fiber 6.095%, hemicellulose 2.946%, cellulose 0.333% and lignin 0.482% [4].

Mastika (2006) stated that one of the plantation commodities that produces substantial biomass or by-products is cocoa (*Theobroma cacao* L) [5]. Currently, the only part of cocoa that is mostly used is the seeds, while the skin is only used as plantation waste which causes environmental damage and rot disease in other cocoa pods. Although the use is limited to making compost and fodder for livestock, the skin of the cocoa pod is rich in chemical compounds that are beneficial to health. Research conducted by R. Shepherd and Yap Tuan Ngan in Malaysia in Roesmanto (1991) showed that cocoa husks and sweating caused by cocoa bean processing can be used as a source of other useful products [6].

Based on these data, cocoa pods can be innovated to create new breakthroughs, cocoa pods which usually become waste are turned into useful products. Cocoa pods can be used as a value-added material because they are rich in phenolics and are therefore a promising source of these compounds [7]. Unfortunately, cocoa pods are very perishable, and to prevent spoilage, reduce chemical reactions, and prolong shelf life, dehydration or drying is an option worth considering [8].

Cocoa pods are processed into a beverage product that is rich in chemical compounds, especially antioxidants that can fight free radicals in the body. Cocoa pods are useful as antioxidants containing theobromine as much as 0.4% w/w and potassium 3-4% w/w in dry matter as well as a mixture of condensed flavonoids such as anthocyanidins, catechins, leucoanthocyanidins which

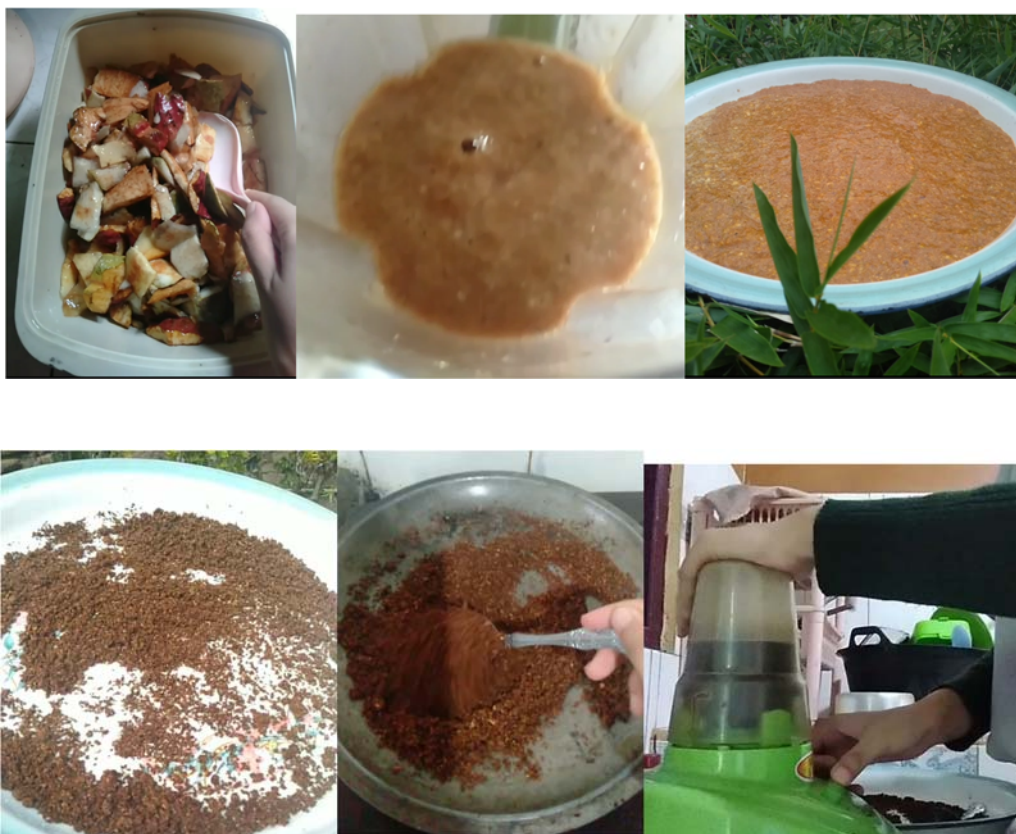
are sometimes bound to glucose, monosaccharides and polysaccharides. (pectin, gum, and cellulose) [9]. Antioxidants play a role in the health of the body because they can inhibit and neutralize free radical oxidation reactions. The product is made by drying method and supported by other complementary ingredients such as ginger powder and milk powder.

II. MATERIALS AND METHODS

Table 1. The ingredients used in making health drinks from cocoa peels are:

No	Bahan	Fungsi
1.	Cocoa peels	The main ingredient for making cocoa powder as well as a source of antioxidants
2.	Sugar	Mixing cocoa powder to give a sweet taste while stabilizing the foam
3.	Creamer	Savory cocoa peel healthy drink
4.	Milk Powder	Add flavor to health drinks
5.	Vanile	Gives a unique aroma and taste to the drink
6.	Ginger Powder	Gives a warm impression when consumed and strengthens the immune system

Process of making cocoa peel herbal drink:





The data collection technique used a literature study obtained from national and international journals with the search terms cocoa peel waste, cocoa peel chemical compounds, cocoa skin antioxidants, benefits of cocoa peel in google scholar and science direct publications and pubmed/medline.

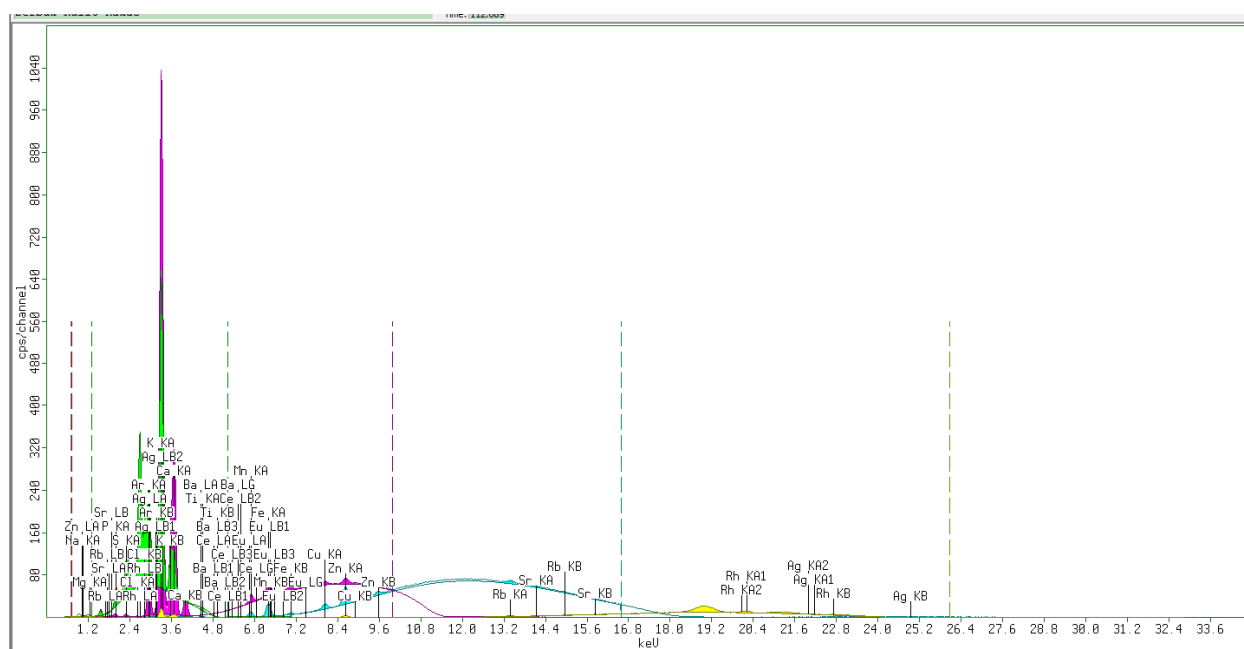
To analyze the element compound in the cocoa peel, sample analysis was carried out using XRF instruments in the chemistry laboratory, Faculty of Mathematics and Natural Sciences, State University Of Padang. Cocoa pod waste used as a sample was obtained from the Sungai Jodi, Kecamatan Lubuk Tarok, Sijunjung, Sumatera Barat.

III. RESULTS AND DISCUSSION

The fresh cocoa pods that have been obtained are then cut into small pieces and washed thoroughly with running water. The purpose of washing is to remove dirt that is still attached to the cocoa pod peel. The clean cocoa pods are then blended for the first time until they are half smooth so that during the second blending the cocoa powder is easier to grind. Furthermore, the blended cocoa shells are dried outside in direct sunlight for approximately 5 to 7 days. The purpose of drying is so that the fungus does not grow on the cocoa skin and it is also intended so that the cocoa skin is completely dry and to avoid the oxidation reaction of the polyphenol compounds in the cocoa pod skin. The next step is roasting the dried cocoa pods for about 15 minutes over medium heat until they are dark brown in color. The goal is to make the cocoa pods more flavorful and to keep the cacao peels from dirt that is still attached. Then the cocoa pod skin is then blended until smooth and filtered using a sieve with a small hole size in order to obtain the size of the cocoa pod skin powder which is soft and smooth as well. Furthermore, the cocoa skin powder is added with complementary ingredients such as sugar, milk, creamer, vanilla and powdered ginger and stirred until evenly distributed and ready to be packaged.



XRF analysis for dried cacao peel



Elemen			Geology			Oxides		
Compound	Conc	Unit	Compound	Conc	Unit	Compound	Conc	Unit
Na	0	%	Na ₂ O	0	%	Na ₂ O	0	%
Mg	0	%	MgO	0	%	MgO	0	%
P	3.719	%	P ₂ O ₅	7.231	%	P ₂ O ₅	7.22	%
S	5.262	%	SO ₃	10.864	%	SO ₃	10.844	%
Cl	0.077	%	Cl	0.061	%	K ₂ O	51.736	%
K	58.496	%	K ₂ O	51.884	%	CaO	27.12	%
Ca	28.793	%	CaO	27.221	%	TiO ₂	0.044	%
Ti	0.04	%	Ti	0.026	%	MnO	0.256	%
Mn	0.304	%	Mn	0.199	%	Fe ₂ O ₃	0.507	%
Fe	0.543	%	Fe ₂ O ₃	0.509	%	CuO	0.089	%
Cu	0.109	%	Cu	0.071	%	ZnO	0.34	%
Zn	0.42	%	Zn	0.274	%	Rb ₂ O	0.063	%
Rb	0.088	%	Rb	0.057	%	SrO	0.043	%
Sr	0.056	%	Sr	0.036	%	Ag ₂ O	1.623	%
Ag	2.017	%	Ag	1.515	%	BaO	0.056	%
Ba	0.075	%	Ba	0.05	%	CeO ₂	0	%
Ce	0.001	%	Ce	0	%	Eu ₂ O ₃	0	%
Eu	0	%	Eu	0	%	Cl	0.061	%

Based on the analysis using the XRF instrument, it was found that in cacao peel powder there were 15 elements, of which the most elements were K with a concentration of 58.496% and Ca with a concentration of 28.793%. Potassium is an important cation in the intracellular fluid that plays a role in balance pH and osmolality while the element Calcium is an essential nutrient

needed for various body functions. Adequate Ca intake is essential for normal growth and development of the skeleton and teeth, as well as for adequate bone mineralization.

Cocoa peel was chosen as the basic ingredient of the product because it contains chemical compounds that are beneficial to the body.

Table 2. Nutrient content contained in cocoa peel [10]

Komponen	Smith dan Adegbola (1982)	Amirroenas (1990)	Roesmanto (1991)
Bahan kering (%)	84,00 - 90,00	91,33	90,40
Protein kasar (%)	6,00 - 10,00	6,00	6,00
Lemak (%)	0,50 - 1,50	0,90	0,90
Serat kasar (%)	19,00 - 28,00	40,33	31,50
Abu (%)	10,00 - 13,80	14,80	16,40
BETN (%)	50,00 - 55,60	34,26	-
Kalsium	-		0,67
Phospor	-		0,10

Sumber: Fitria (2015)

Table 3. The results of testing the antioxidant activity of cocoa pod peel and vitamin C using the DPPH method [15]

Sampel uji	Konsentrasi (µg/mL)	Rata-rata %inhibisi (%)	Nilai IC ₅₀ (µg/mL)	Keterangan
Ekstrak Kulit	25	78,12		
Buah kakao	20	67,2		
	15	48,43	15,46	Sangat Kuat
	10	37,5		
	5	18,74		
	0			
	10	83,32		
	5	45,45		
Vitamin C	2,5	21,21	5,07	Sangat Kuat
	1,25	12,12		
	0,625	7,57		
	0			

Table 4. Measurement results of flavonoid levels from methanol extract of cocoa pods by the AIC13 method [16].

Serapan	Konsentrasi (µg/ml)	Kadar Flavonoid
0.2749	47.8750	0.2368
0.2756	48.0000	0.2374
0.2753	47.9464	0.2372
Rerata Kadar Flavonoid		0.2371
SD		0.0004
% SD		0.1276

Healthy drinks from cocoa peel are very useful for the body because they contain chemical compounds such as water content as much as 12.96%, ash 11.01%, fat 1.11%, protein 8.75%, carbohydrates 16.27%, lignin 20.11%, cellulose 31.25% and hemicellulose 48.64%. Cocoa pods contain polysaccharides (hemicellulose 36.23% and cellulose 1.14%) and lignin around 20-

27.95% [11] and a small part consisting of phenolic compounds, tannins, cocoa butter and purine alkaloids [12]. Cocoa pods can be used as a source of polyphenols whose components consist of catechins, anthocyanins and proanthocyanidins [13]. In addition, antioxidants from outside the body such as those found in cocoa peel can repair damaged skin cells, which is very necessary because with age the production of antioxidants in the body decreases [14].

IV. CONCLUSION

The conclusion that can be obtained from this review is that cocoa peel can be used as a raw material for making health drinks because it contains chemical compounds like antioxidant, phenolics which is very beneficial for the health of the human body if consumed regularly and not excessive.

Based on analysis of samples XRF shows that in cacao peel contains the most potassium and calcium elements which also have many health benefits.

ACKNOWLEDGMENT

The researcher would like to thanks Mr. Effendi, S.Pd, M.Sc as a supervisor so that this article can be completed properly and also to the Chemistry Laboratory of the State University of Padang who has helped researchers to analyze samples using XRF instruments.

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