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Physico-Chemical Qualities of Chocolate Bars Produced from Cocoa and Oats Sweetened with Honey

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Abstract: *Cocoa and oats were used to produce chocolate bars, while honey was used as the sweetener. The cocoa and oats were used in the following respective ratios: 100:0(A), 90:10(B), 85:15 (C), 80:20 (D) to produce chocolate bars. The physic-chemical properties: functional properties of flour, physical properties, proximate composition and sensory attributes of chocolate bars were evaluated using standard methods described by AOAC. Data was analysed at p=0.05 significant level, the results showed significant difference p<0.05. The functional properties: WAC, OAC, bulk density, swelling capacity, dispersibility ranged respectively from: 0.37 to 0.8 mL/g, 0.19 to 0.43 mL/g, 0.48 to 0.72 g/mL, 2.05 to 4.50 %/g, 71.0 to 79.0 %, 20.1 to 29.1 s. The physical properties, weight ranged from: 44.51 to 50.62 g, the width ranged from 5.61 to 5.80 cm, the length ranged from 12 .20 to 12.63 cm, the thickness ranged from 0.22 to 0.32 cm, the spread factor ranged from 17.0 to 25.9. The proximate compositions: moisture, crude protein, crude fat, crude fiber, ash and carbohydrate ranged respectively from: 8.40 to 13.1 %, 7.015 to 7.30 g/100g, 27.0 to 30.2 g/100g, 2.06 to 3.25 g/100g, 1.65 to 2.75 g/100g, 46.22 to 49.30 g/100g. For the sensory attributes, the appearance ranged from 7.58 to 8.05, the aroma ranged from 7.0 to 7.79, the taste ranged from 7.00 to 7.53, the texture ranged from 6.89 to 7.79, and the general acceptability ranged from 7.63 to 7.94. The results showed that chocolate bars which are generally accepted and of good nutritional properties can be produced from cocoa and oats sweetened with honey.*

Keywords: *cocoa, oats, honey, nutrition.*

1. Introduction

Cocoa beans are used in chocolate manufacturing as well as serving as ingredients for the manufacture of other food products. Chocolate is a semi-solid suspension made of fine solid particles of sugar, cocoa, milk powder and other ingredients depending on the type, making about 70% total, in a continuous fat phase which is usually cocoa butter cocoa [1].Chocolate has proven to be one of the most promising foods due to its high content of polyphenolic compounds such as: flavonoids which are good for health properties [2].Bar chocolate is one type of chocolate that is widely consumed throughout the world. One key element of chocolate texture is having a semi-solid base at room temperature, but it is easy to melt when consumed in the mouth at 37^{o}C (normal body temperature) [3].

Chocolate, the main product from cocoa, contains compounds that are reported to be beneficial antioxidant, especially interesting for cardiovascular health[4]. Chocolates unlike cookies are mostly consumed by children; adults also consume chocolates [5]. The process of producing chocolate from cocoa, you need a mixture of cocoa or cocoa powder, cocoa butter and sugar. Depending on the product you want to obtain, other ingredients such as milk, almonds, hazelnuts, fruits, etc. can be added. The phases of chocolate manufacture are: roasting of cocoa beans, grinding, mixing, fine grinding, conching, tempering, molding into desired shapes and packaging. Separating the cocoa butter will need additional phase of alkalization [6].Studies have shown that chocolate provides a great amount of energy to the human body, keeping the brain part active, achieving great mental abilities. Cocoa contains between 10 and 22% fat, consisting mainly of fatty acids: oleic, palmitic and stearic, as well as other organic acids [7].

Honey is a sweet, viscous liquid prepared by collecting nectar from plants by honey bees [8]. It has a pleasant flavour, aroma and taste which range from pale yellow to dark amber depending on geographical/seasonal conditions. It was used as a sweetener in ancient times as well as for medicinal purposes[9].Honey contains glucose and fructose of about 70 - 80%, water10 - 20% and other constituents such as organic acids, mineral salts, vitamins, proteins, phenolic compounds and free amino acids in small amount [10].Honey is largely used on a small scale as well as at household and industrial level in beverages, baked products, confectionary, candy, marmalades, jams, and other products; also, honey can be used alone or in combination for the minimizing certain diseases [11,12].

Increasingly, consumers are more concerned with the sugar and calorie content as well as the carcinogenicity of confectionery products, with 'light' and 'sugar-free' products growing in popularity. This has made to the choice of preferring food product with less sugar or caloric value than same food with higher sugar or caloric value. The growing knowledge on these products has led to an increased quest for the use of alternative sweeteners in food products.

2. Materials and Methods

2.1 Procurement of Raw Materials

The raw materials for the study: oats, cocoa and honey where bought from the Bamenda main market Cameroon and taken to the Catholic university of Bamenda laboratory for production of chocolate and further analysis.

2.2 Preparation of Raw Materials and Sample Formulation

Cocoa beans bought where sorted, roasted, cracked and winnowed and then crushed. The cocoa powder was separated from the cocoa butter. The flour samples were divided into four, with the following ratios of wheat: Oats; 100:0(A), 90:10(B), 85:15 (C), 80:20 (D).

2.3 *Production of Chocolate Bars*

The chocolates were produced using standard methods of Meyer[13] with modifications. The ingredients: 75 mL butter, 125 mL cocoa powder/oats, 75 mL honey, 5mL vanilla extract were used to produce the chocolate bars. The cocoa butter was heated to melting point, and then blended in cocoa powder/oats, honey was added and the mixture stirred to a fine consistency, vanilla added. The mixture was stirred to a fined consistency and pressed lightly into greased square pan. It was cool at refrigeration temperature for 24hours, removed, cut into bars and then packaged.

2.4 Analysis

The functional properties, proximate composition, physical characteristics of the chocolate bars where analysed using the method described by AOAC [14]

2.5 Sensory Analyses

Sensory evaluation of chocolate bars was carried out using 20 panelist comprising food science and nutrition BSc students and staff of CATUC Bamenda. Panelist were required to evaluate the aroma, appearance, taste, mouth feel and overall acceptability of the chocolate bars using a 9-point Hedonic scale with 1 = dislike extremely, 2 = dislike very much, 3 = dislike moderately, 4 = dislike slightly, 5 = neither like nor dislike, 6 = like slightly, 7 = like moderately, 8 = like very much, 9 =like extremely [15].

2.6 Statistical Analysis

Microsoft Excel 2010 computer software was used to analyze the data. Mean and standard deviation calculated where appropriate. Analysis of variance (one way ANOVA) was used to determine the significant difference in treatments differences was considered at 95% ($p<0.05$)significant level. The T-test was used to separate the means.

3. Results and Discussion

Results of the functional properties of the flours are shown on Table 4.1. They was significant difference in the functional properties of flours, water adsorption capacity(WAC) was lower in cocoa 0.41mL/g than Oats 0.5mL/g, it signifies the maximum amount of water a particular flour can adsorbed. The oil adsorption capacity (OAC) increased from 0.19 to 0.43 mL/g. The bulk density was higher in oats 0.65 g/mL than cocoa flour 0.48 g/mL; the bulk density is an important parameter in packaging and transporting material. The swelling capacity increased from 2.05 to 4.50 %/g. The dispersibility degreased from 76.5 to 71.0%, it describe how ease the flour particles can be distributed. These results are similar to those of Mulak et al., [5] and Ndife et al., [16]. The wettability described how easy the sample can be wetted by water to possess instant characteristics, values ranged from 20.1 to 29.1 s, lesser than 19 to 54 seconds reported by Ndife [16].

The results of the physical properties of the chocolate bars are shown on Table 4.2 with significant difference among samples, the weight of the samples increased while the width and length ranged from 5.61 to 5.71 cm and 12.0 to 12.63 cm respectively. The thickness and spread factor ranged from 0.22 to 0.32 cm and 17 to 18.5 respectively. The smaller the spread factor, the better the sensory quality of the sample, hence sample D (80:20) had the smaller spread factor [17].

Results of the proximate composition of the chocolate bars are shown on Table 4.3 below with significant difference among the samples. The moisture content of the samples increased from 8.40 to 13.1 g/100g, this can be attributed to the increase in oats ratio in the samples, lower moisture content will limit the growth of bacteria and molds and also improve the products shelf life [18].Ash content ranged from 1.65 to 2.45 g/100g, as content signifies the total amount of

minerals present in a food sample Mulak et al., [19]. These results were higher than a moisture content of 5.12 to 7.10% reported by Ndife et al., [16]. The crude protein content of the samples decreased from 7.30 to 7.05 g/100g and was not significant. The crude fat content of the samples decreased from 30.2 to 27.0 g/100g, this decrease of fat content was as a result of increase substitution of cocoa with oats. The crude fiber content of samples ranged from 2.06 to 3.25 g/100g, this increases in fiber content can be attributed to higher fiber content of cocoa as well as the honey used and addition of oats. The carbohydrate content decreased from 49.30 to 46.22 g/100g. This decrease in carbohydrate content among samples is due to the differences in the other proximate parameters. The carbohydrate results were lower than values of 50.19 to 62.12 g/100g reported byAtef et al., [20] due to the use of honey rather than sugar, hence a reduction in the sugar content.

TABLE 4.1: FUNCTIONAL PROPERTIES OF THE PROCESSED FLOURS

Samples C:O	WAC (mL/g)	OAC (mL/g)	Bulk density (g/mL)	Swelling capacity (%/g)	% Dispersebility	Wettability (sec)
A(cocoa)	0.41^{ab}±0.01	0.19^{a}±0.07	0.48^{a}±0.03	2.05^{a}±0.07	76.5^{b}±0.12	29.1^{c}±0.18
B 90:100	0.80^{c}±0.010	0.21^{a}±0.01	0.68^{b}±0.01	2.95^{b}±0.07	77.5^{b}±0.91	27.7^{c}±0.92
C 85:15	0.41^{ab}±0.01	0.29^{a}±0.01	0.72^{c}±0.01	2.85^{ab}±0.07	79.0^{b}±1.10	25.8^{b}±1.10
D 80:20	0.37^{a}±.0020	0.24^{a}±0.21	0.71^{c}±0.00	2.65^{ab}±0.07	79.5^{b}±0.50	22.4^{b}±0.50
Oats	0.50^{b}±0.020	0.43^{a}±0.23	0.65^{a}±0.07	4.50^{c}±0.71	71.0^{a}±0.010	20.1^{a}±0.01

All values are means ±SD of duplicate readings. Means within a column with the same superscript were not significant difference (P> 0.05).

TABLE 4.2: PHYSICAL PROPERTIES OF THE PROCESSED CHOCOLATE

Samples	Weight (g)	Width (cm)	Length (cm)	Thickness (cm)	Spread factor
A 100:0	46.15^{a}±0.21	5.71^{b}±0.01	12.63^{b}±0.14	0.30c±0.00	18.5^{ab}±0.71
B 90:10	45.83^{a}±1.17	5.80^{c}±0.01	12.20^{a}±0.14	0.22a±0.01	25.9^{c}±0.71
C 85:15	50.62^{b}±0.87	5.70^{b}±0.01	12.53^{a}±0.11	0.27b±0.01	20.6^{b}±0.78
D 80:20	44.51^{a}±0.72	5.61^{a}±0.01	12.33^{a}±0.11	0.32d±0.001	17.0^{a}±0.71

All values are means ±SD of duplicate readings. Means within a column with the same superscript were not significant difference (P> 0.05).

TABLE 4.3: PROXIMATE COMPOSITION OF THE PROCESSED CHOCOLATE g/100g

Samples C: O	Moisture	Crude Protein	Crude Fats	Crude Fibre	Ash	Carbohydrates
A 100:0	8.40^{a}±0.14	7.30^{a}±0.56	30.2a±0.28	2.40^{ab}±0.14	2.45^{b}±0.11	49.30^{bc}±0.07
B 90:10	9.35^{b}±0.21	7.20^{a}±0.14	29.0a±1.4	2.65^{b}±0.10	2.75^{c}±0.07	49.03^{bc}±0.04
C 85:15	9.55^{b}±0.01	7.025^{a}±0.32	32.1a±0.78	3.25^{b}±0.35	1.65^{a}±0.07	46.22^{a}±0.30
D80:20	13.1^{c}±0.14	7.05^{a}±0.21	27.0a±4.2	2.06^{a}±0.06	2.25^{b}±0.07	48.27^{b}±0.38

All values are means of duplicate readings. Means within a column with the same superscript were not significant difference (P> 0.05).

TABLE 4.4: SENSORY ATTRIBUTES OF THE CHOCOLATE BARS

Samples C:O	Appearance	Aroma	Taste	Texture	General acceptability
A 100:0	7.58^{a} ± 1.2	7.00^{a} ± 1.3	7.32^{a} ±1.5	6.89^{a} ±1.7	7.68^{a} ±1.1
B 90:10	8.00^{a} ± 1.1	7.28^{a} ± 0.8	7.00^{a} ±1.5	7.05^{a} ±1.8	7.74^{a} ±1.4
C85:15	8.05^{a} ± 1.7	7.44^{a} ± 1.2	7.63^{a} ±1.3	7.79^{b} ±1.0	7.63^{a} ±1.4
D 80:20	7.78^{a} ± 1.6	7.78^{ab} ±1.1	7.53^{a} ±1.0	7.74^{ab} ±1.4	7.94^{a} ±1.5

All values are means ±SD of 20. Means within a column with the same superscript were not significant difference (P> 0.05).

The sensory attributes of the chocolate samples are shown on Table 4.4. They was no significant difference in the appearance of the samples with values ranging from 7.58 to 7.78, this can be attributed to the dominant cocoa colour in all the samples. Sample D with highest level of oats substitution had a significant value for aroma 7.78 from the other samples; this difference in aroma was impacted by oats. Ahure et al., [21] reported that increase substitution of composite flour can affect the aroma of the food product. They were no significant difference in the sample taste, the texture ranged from 6.89 to 7.79 a similar ranged of results has been reported by Luděk et al., [22], this increase was due to the increase in oats concentration in the sample. All samples were generally accepted by the sensory panelist with scores ranging from 7.63 to

7.94. Hence chocolates produced with the above blends of cocoa and oats will be highly appreciated by consumers, this result was in range with those reported by Vyakhaya et al., [23].

4. Conclusion

Producing chocolate bar from cocoa and oats sweetened with honey had beneficial nutritional properties; all samples were generally accepted by the sensory panelist. Hence low sugar content chocolates can be produced from cocoa and oats sweetened with honey as alternative to sugar.

References

[1] E. OAfoakwa,. *Cocoa production and processing technology* (pp. 183–195): CRC Press Taylor & Francis Group, 2014. (Chapter 13).

[2] JDelgado, JMandujano, DReátegui, & EOrdoñez. Development of dark chocolate with fermented and non- fermented cacao nibs: total polyphenols, anthocyanins, antioxidant capacity and sensory evaluation. *Scientia Agropecuaria.* https://doi.org/10.17268/sci.agropecu. 2018.04.10

[3] Y.W. Chen, M.R. Mackley: Flexible chocolate. *Soft matter journal*.2006 Vol. 2, p. 304.

[4] L. Y. CAmaya,., &, L. C. OPabón. Chocolate: más que un dulce. *Revista CONVICCIONES 2017.*

[5] D. G Mulak, D Ahure, and M. O. Eke(2020). Production and Quality Evaluation of Cookies from Wheat, Almond Seed and Carrot Flour Blends. *International Journal of Food Science and Biotechnology*. Vol. 5, No. 4,, pp. 55-61.

[6] J. MOliveras. La elaboración del chocolate , una técnica dulce y ecológica. *Técnica Industrial*, 2007 *268*, 47–51.

[7] S.Waizel, J.Waizel,, J. AMagaña, PCampos,& J. ESan Esteban,. Cacao y chocolate : seducción y terapéutica. *Anales Médicos 2012 ch4*.

[8] A.R Aparnaand DRajalakshmi. "Honey- Its characteristics, sensory aspects, and applications". *Food Reviews International* 15 1999): 455-471.

[9] FAO. Food and Agriculture Organization. Value-added products form beekeeping". FAO Agricultural Services Bulletin. Orme, Italy (1996).

[10] SOuchemoukh.. "Physicochemical characteristics and pollen spectrum of some Algerian honeys". *Food Control* 18 (2007): 52-58.

[11] PJuvvi.,. "Optimization of process variables to develop honey based extruded product". *African Journal of Food Science* 6 (2012): 253-268.

[12] B. Sharma*, D. Vaidya, M. Kaushal and S. P. Singh.Utilization of honey for functional food product development.Acta scientific nutritional health (issn:2582-1423) 2020 volume 4 issue 4 april.

[13] JMeyer,. (2009). Chapter 19 Manufacturing processes: Production of chocolate shells. In G. Talbot (Ed.), *Science and technology of enrobed and filled chocolate, confectionery and bakery products* (pp. 416–426). Woodhead Publishing Ltd.

[14] AOAC. Official methods of analysis. Association of official analytical chemists. 18th edition. Washington D. C. USA; 2010

[15] OAkinjayeju. Quality control for the industry: A statistical approach. Lagos: Concept Publications. J. Food Science and Nutrition. 2009;4(3):364-369.

[16] J. Ndife, P.Bolaji, D. Atoyebi and C.Umezuruike. Production and quality evaluation of cocoa products (plain cocoa powderand chocolate). *American journal of food and nutrition*,2013 ISSN 2157-1317, doi:10.5251/ajfn.2013.3.1.31.38

[17] NJoel, KFatima., and FStephen.,. Production and quality assessment of enriched cookies from whole wheat and full fat soya. *European Journal of Food Science and Technology*. 2014 Vol. 2, No. 1, pp. 19-28.

[18] T.G Guehi,., I.BZahouli., L Ban-Koffi,, M.AFae, and, J.GNemlin. Performance of different drying methods and their effects on the chemical quality attributes of raw cocoa material. *International Journal of Food Science and Technology*, 2010; 45: 1564-1571.

[19] D. GMulak.*, B. B, Ndi, E. L. Chi, M. G. Muyong, F. M. Atam. Proximate composition of baked foods produced from various composite flour: a review.*Journal of Postharvest Technology*, 2021 09(4): 74-83.

[20] AAtef. A. Zaid and, A.SNadir. Quality Evaluation of Nutritious Chocolate and Halawa Tahinia Produced with Moringa (*Moringa oleifera)* Leaves Powder. *Middle East Journal of Applied Sciences, 2014* 4(4): 1007-1015.

[21] D. Ahure, D. G. Mulak and M. O. Eke. Vitamin Content and Storage Studies of Cookies Produced from Wheat, Almond and Carrot Flour Blends. *Asian Food Science Journal 2020 15(3): 31-41.*

[22] L. Hřivna, L. Machálková, I. Burešová, Š. Nedomová1, Tomáš Gregor1.Texture, color, and sensory changes occurring in chocolate barsmwith filling during storage.*Food Science & Nutrition*2021:00, 1–11. https://doi.org/10.1002/fsn3.2434.

[23] J. D.Vyakhayaand R. Parvez.Evaluation of the quality and sensory attributes of chocolate under different trials.*The Pharma Innovation Journal* 2019; 8(5): 729-733