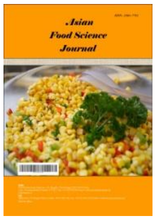

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Nutritional Profile and Organoleptic Qualities of Milk Chocolate Incorporated with Different Spices

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Authors' contributions

This work was carried out in collaboration among all authors. Authors SOA, AFO and AOO designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author ASO managed the analyses of the study. Author MAOA carried out the sensory analysis and managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

An innovative spicy chocolate was developed in this study by partial replacement of cocoa nibs with different selected spice powders of: Ginger (G_{11}), Garlic (G_{12}), Clove (C_{13}), Cinnamon, (C_{14}), Turmeric (T_{15}), *Aframomum danielli*, (A_{16}), *Aframomum melegueta*, (A_{17}), Thyme (T_{18}), Black Pepper (B_{19}) and Clappertonia (C_{20}). Milk chocolate without spices (C_{10}) served as Control. The proximate compositions were carried out using standard methods. The Total Calorific values (TCV) was determined using the Atwater factors (physiological fuel values) of 4kcal, 4kcal and 9kcal per gram of carbohydrate, protein and fat respectively. The sensory evaluation was carried out by panel of tasters consisting of 13 males and 18 female staff of the Cocoa Research Institute of Nigeria who were used to consuming chocolates. The result showed significant differences in the proximate chemical compositions of the chocolates at ($p<0.05$). The range of values obtained for the proximate compositions were: Protein (6.34 - 7.44); Fat (31.53 - 34.42), Ash, (2.27 - 2.81), Moisture Content (5.06 - 5.86). Crude fibre (2.35 - 2.68% and Carbohydrate (47.83 - 51.63) respectively. Apart from black pepper with a significantly lower protein and ash contents than the control chocolate, the incorporation of other spices significantly resulted in an increase in percentage protein and ash in the control milk chocolate. The trend in protein increase is T18 > G11 > T15 > C20 = A17 > A16 > C14 > C13 > G12 > C10 > B19. The Total Calorific Value (TCV) also showed significant differences among all the samples at $p<0.05$ with the TCV of the control

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chocolate being the highest. The addition of spices contributed to acceptable tastes, aroma, flavor and general acceptability of milk chocolates. In Conclusion, this study showed that the incorporation of Spices in chocolate increased the protein and ash content of milk chocolate, while reducing the TCV values This is a desirable findings in view of the fear of high calorific values of Milk Chocolate which may predispose consumers to Obesity when consumed in large quantities.

Keywords: Spices; chocolate; nutritional; organoleptic; cocoa beans.

1. INTRODUCTION

Considerable interest has developed recently on the preservative effects of spices in grains and legumes because of the presence of compounds that can control the growth of spoilage microorganisms (bacteria and moulds) in them [1,2]. Some of the spices have also been used as antioxidants capable of reducing oxygen radicals which predispose food products to oxidative deterioration consequential to development of off flavor, off-odour and changes in the taste of foods and its palatability [3]. Spices have been used for many years as flavouring agents in foods and other culinary activities [1]. Using spices in foods make it a significantly acceptable additives since it falls in the category of GRAS referred to as (Generally Regarded as Safe) for consumption by USFDA [2]. This has also necessitated their use in different food products such as Dairy, confectionery, alcoholic and nonalcoholic beverages, meats, fats and oils [1-6]. Recent advances in food safety has condemned the use of chemical additives for food preservation because of the resultant carcinogenic and mutagenic effects it imparted on human [7]. However, the utilization of spices in chocolate was reported by Fatima and Ali [8] who developed a functional chocolate with some spices and lemon peels powder and optimized their uses by applying the response surface Methodology. Aroyeun [9] formulated milk chocolate containing *Aframmomum danielli* and reported the possibility of using *Aframomum danielli* spice powder in chocolate. Chocolate is a highly nutritious energy source with a fast metabolism and good digestibility. The presence of cocoa, milk, and sugar in its composition can be the warranty of an appropriate ingestion of proteins, carbohydrate, fats, minerals and vitamins [10] but unfortunately, it is seldom consumed in Nigeria owing to the general belief that its consumption is associated with some cardiovascular diseases. Despite this, chocolate is an example of most widely relished confectionery product because of its health benefits. Making chocolate to be more functional involved the addition of so many other non chocolate materials like fruits, vegetables, legumes and some spices such as Aniseed, Ginger, and lemon peels which are known to have some nutritional benefits or some antimicrobial or antioxidant properties [8-12]. A detailed literature review has shown that there is a paucity of information on the characteristic proximate compositions of chocolate into which spices have been incorporated and the sensory qualities. This work was designed to fill these gaps in knowledge. The objectives of this work is to evaluate the nutritional compositions, sensory profiles and total calorific values of chocolates into which spices have been incorporated.

2. MATERIALS AND METHODS

Aframomum danilli, *Aframomum melegueta*, cinnamon, black pepper, thyme, ginger, cloves, *clappertonia* and turmeric powders were obtained from the general local Market in Ibadan Metropolis. Other ingredients like milk powder, sugar, lecithin and cocoa butter were purchased from the Agbeni Market, Ibadan, Nigeria. Spices were sorted, dried at ambient temperature (28ºC) and ground into a fine powder and preserved in a sealed polythene bag to avoid moisture absorption prior to its utilization in the chocolate production.

2.1 Chocolate Bar Production

Chocolate bar was prepared according to the modified method of Aroyeun and Jayeola [13]. Cocoa pods were harvested at the matured stage when the pods had turned yellowish or brownish on the outside. The harvested pods were taken to the fermentary where pods were broken to extract the wet beans from the pods in preparation for cocoa bean fermentation using tray fermentation method for 5 days. After the expiration of fermentation, the cocoa beans were dried under the sun for 7-8 days to a moisture content of < 6%. The dried cocoa beans were later transported to the chocolate laboratory at the Cocoa Research Institute of Nigeria, Ibadan for roasting in Gallenkamp oven at temperature of 120ºC-123ºC for 1 hour, air-cooled, shelled and winnowed manually to separate shells from nibs The essence of roasting was to generate a volatile flavor characteristics for the chocolate and soften the testa for its easy removal. The roasted beans were later deshelled manually and winnowed to obtain the cocoa nibs. The cocoa nibs were weighed (approximately 5 kg and ground into a liquor in a laboratory grinder. At the point of grinding, the spices were added as a partial replacement of the cocoa nibs at a w/w level. After grinding the cocoa nibs into liquor, cocoa butter, lecithin, sugar and milk were added in that order.The chocolate paste was then refined in three-roller refining machine followed by Conching with cocoa butter in a conching machine at 65ºC-70ºC for 5 hours, the chocolate paste was manually tempered to obtain a stable cocoa butter crystals within the chocolate. The chocolate was then moulded, wrapped and stored in refrigerator (Fig. 1).

The flow chart of chocolate processing is shown in Fig. 1 and the recipe of the chocolate is shown in Table 1.

2.2 Proximate Analysis

Proximate analysis of all the chocolate samples were carried out according to AOAC [14]. Moisture was determined by the atmospheric oven method (100-102ºC for 16 h), until constant weight. Protein content was determined by the micro-Kjeldahl method, using a nitrogen conversion factor of 6.25. Crude fat was determined using the Soxhlet method with hexane as solvent. Ash by ignition in a muffle furnace for 10 min at 550ºC. The carbohydrate contents were obtained by difference. The Total Calorific values (TCV) was determined using the Atwater factors (physiological fuel values) of 4 kcal, 4 kcal and 9 kcal per gram of carbohydrate, protein and fat content of the samples respectively. All the analyses were done in triplicate.

2.3 Sensory Analyses

The chocolate tasting tests were done after 2-day storage at 4ºC in a refrigerator. For this purpose, an eleven differently coded samples of the spicy chocolates and the Control were presented to a 21-member sensory panelists who are regular eaters of chocolate and who had been previously selected from the staff of the Cocoa Research Institute of Nigeria and students on industrial attachment from different universities in Nigeria (Males = 13, Females = 8). The global quality and the intensity of each

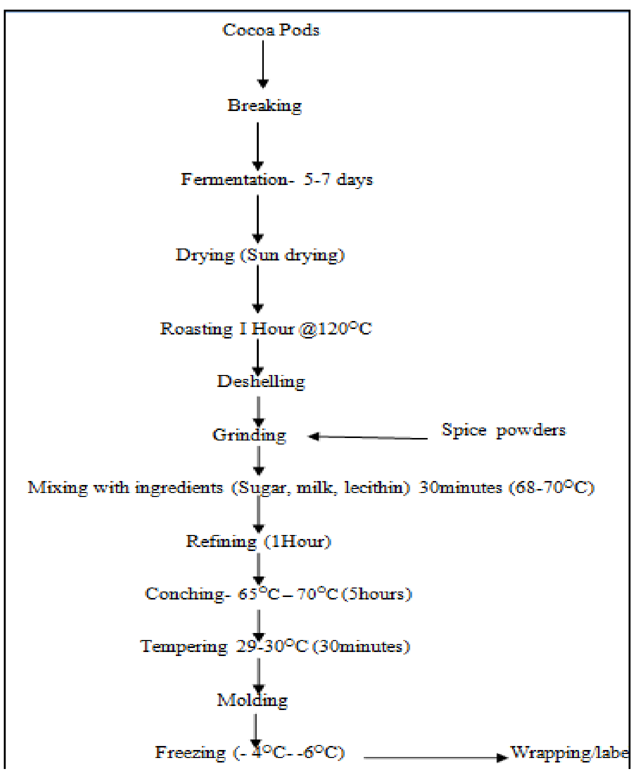

Fig. 1. Flow chart for spicy chocolate production [13]

Table 1. Formulation of enriched milk chocolate with different spices (g)

Compositions	C10	G11	G12	C13	C14	T15	A16	A17	T18	B19	C20
Cocoa Mass	65	46	46	46	46	46	46	46	46	46	46
Sugar	82	82	82	82	82	82	82	82	82	82	82
Cocoa butter	24	24	24	24	24	24	24	24	24	24	24
Milk	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5	44.5
Lecithin	3.00	3	3	3	3	3	3	3	3	3	3
Spice powder	0	19	19	19	19	19	19	19	19	19	19

Legends: C10—Control milk chocolate, G11—Ginger, G12—Garlic, C13—Clove, C14 Cinnamon, T15—Tumeric, A16-Aframomum danielli, A17-Aframomum melegueta, T18—Thyme, B19---Black pepper, C20--- Clappertonia, CHO-Carbohydrate; M.C. –Moisture content

attribute was evaluated simultaneously using hedonic scale 0-9, where 0 represents dislike extremely and 9 represents like extremely. The sample codes used were: C10—Control milk chocolate, G11—Ginger, G12—Garlic, C13—Clove, C14 Cinnamon, T15—Turmeric, A16-*Aframomum danielli*, A17-*Aframomum melegueta*, T18—Thyme, B19---Black pepper, and C20---Clappertonia, respectively.

The sensory analyses used by Aroyeun and Jayeola [13] was adopted. Determination of sensorial profile of all the chocolate samples were performed with a descriptive analysis of the ISO 13299 in the Cocoa Research Institute of Nigeria tasting room. In this method, each taster was given an evaluation form for each of the chocolate samples. The form included four sensory attributes of Taste, Odour, Aroma, Flavour and Overall acceptability. The tasting was carried out in a well illuminated tasting room. Tasters were put in a tasting booth and separated from each other with a square plywood and were prevented from communicating with each other to avoid undue bias in sensory judgment during the tasting session. Tasters were provided with water to rinse their mouth after a round of tasting.

2.4 Statistical Analyses

The statistical analyses of all the data collected were carried out with the XLSTAT (Microsoft) software version 19.02. 2017. Analyses of variance (ANOVA) were performed to indicate the significant differences among the sensory attributes in the chocolate samples Means were separated using Duncan's Multiple Range Test and significance were determined at $p<0.05$.

3. RESULTS AND DISCUSSION

3.1 Proximate Composition

The proximate composition of the chocolate samples in this study is shown in Table 2. From the results obtained, highly significant differences were recorded for all the proximate chemical compositions of the chocolate samples. Since the amount of spices added to the milk chocolate was the same, it is easy to detect a significant contribution of each spice to the overall chemical and sensorial properties of the made spice supplemented chocolates. According to Table 2, the protein content ranged between 6.34-7.44% while the percentage fat content of the chocolate samples fell between 31.83%-34.43. The percentage crude fibre ranged between 2.35-2.68%. The values obtained for the Ash contents ranged between 2.21-2.81%. Apart from samples C14 and G11, all the remaining chocolates contained significantly reduced carbohydrate contents which is a desirable results since increase in carbohydrate values in food samples causes an increase in sugar contents which may be a worry to the diabetes and those who have issues bothering on sugar and health. The control chocolate contained about 48.8% in carbohydrate when compared to other samples while the chocolate with *Aframomum danielli*, (A16), *A.* melegieta (A17), cloves (C13), Clappertonia (C20), Garlic (G12), Turmeric (T15), Thyme (T18), significantly resulted in reduction of carbohydrate which consequently resulted in reduction of the Total calorific values of the Milk chocolates. The moisture contents of the chocolate containing spices were significantly different from the control sample and ranged between 5.06% and 5.86%. These values were far higher than the value reported by Aroyeun and Jayeola, 2016 who used green tea to supplement milk chocolate in green tea chocolate production. The values reported by Aroyeun and Jayeola ranged between 1.15-2.15%. There are two possibilities for the variation in values with this current study: i. The initial moisture content of the supplementing spice and the moisture pick up after the processing stage. [5] also reported a similar value to Aroyeun and Jayeola [13] One could probably assume that the moisture content of

Table 2. Proximate chemical composition of chocolate supplemented with different spices

Chocolate samples	% Protein	% Fat	% CF	% Ash	% M.C	% CHO
A17	7.23 ± 1.6	34.38 ±1.2	2.35 ±2.04	2.59 ±2.55	5.6 ±3.11	48.5 ±2.22
A16	7.03 ±2.4	34.43 ±2.8	2.41 ±1.7	2.65 ±2.2	5.65 ±1.88	47.83 ±1.2
B19	6.34 ±1.5	32.27 ±1.6	2.43 ±2.7	2.27 ±1.5	5.06 ±2.55	51.63 ±2.9
C10	6.83 ±1.45	33.58 ±1.6	2.68 ±2.00	2.36 ±1.12	5.74 ±2.4	48.81 ±1.7
C13	6.92 ±2.3	33.631.86	2.50 ±2.11	2.44 ±2.66	5.86 ±1.22	48.65 ±2.8
C20	7.23 ± 1.03	33.83 ±2.9	2.54 ±2.2	2.57 ±1.06	5.59 ±1.4	48.24 ±1.7
G11	7.34 ±2.1	31.53 ±1.1	2.60 ±2.0	2.81 ±1.6	5.84 ±2.2	49.88 ±1.2
G12	7.01 ±2.6	33.1 ±2.3	2.57 ±2.4	2.762.8	5.79 ±1.1	48.77 ±2.5
T15	7.33 ±2.6	34.17 ±2.1	2.42 ±1.8	2.47 ±1.9	5.68 ±2.4	47.93 ±1.1
T18	7.44 ±2.3	34.25 ±1.1	2.38 ±2.3	2.43 ±1.3	5.65 ±1.5	47.85 ±1.8
C14	7.11 ±1.7	33.26 ±2.3	2.47 ±1.7	2.51 ±0.77	5.62 ±0.99	49.03 ±0.1

Legends: C10—Control milk chocolate, G11—Ginger, G12—Garlic, C13—Clove, C14 Cinnamon, T15—Tumeric, A16-Aframomum danielli, A17-Aframomum melegueta, T18—Thyme, B19---Black pepper, C20 --- Clappertonia, CHO-Carbohydrate; M.C. – Moisture content

Table 3. Sensory analyses of chocolates incorporated with different spices

Chocolate samples	Taste	Aroma	Texture	Colour	Overall acceptability
G11	5.75 ± 1.916	6.2 ± 2.093	6.75 ± 1.070	7.10 ± 1.190	6.45 ± 1.40
G12	5.15 3± 2.25	5.75 ± 1.552`	5.85 ± 1.349	7.35 ± 0.990	5.4 ± 2.30
C13	3.65 ± 1.814	4.75 ± 2.221	5.95 ± 1.349	6.65 ± 1.630	4.4 ± 2.14
C14	5.5 ± 2.013	5.35 ± 2.007	6.65 ± 1.270	7.15 ± 1.840	6.2 ± 1.82
T15	4.25 ± 2.150	4.55 ± 2.080	4.75 ± 2.074	3.7 ± 1.840	4.3 ± 2.05
A16	4.95 ± 2.164	6.7 ± 1.892	5.7 ± 1.780	7.25 ± 1.41	6.00 ± 1.49
A17	6.45 ± 1.538	6.25 ± 1.410	5.5 ± 1.431	7.3 ± 1.170	6.25 ± 1.37
T18	4.75 ± 2.074	5.20 ± 2.000	5.15 ± 8.140	6.95 ± 1.54	5.2 ± 2.12
B19	5.65 ± 2.183	5.60 ± 1.875	6.45 ± 1.960	6.70 ± 1.53	5.65 ± 2.06
C20	2.80 ± 1.399	3.75 ± 2.100	5.05 ± 2.039	7.1 ± 2.100	2.063.55 ±
C10	8.4 ± 0.503	7.7 ± 0.660	7.65 ± 0.750	7.3 ± 0.920	8.1 ± 0.45

Legends: C10—Control milk chocolate, G11—Ginger, G12—Garlic, C13—Clove, C14 Cinnamon, T15—Tumeric, A16-Aframomum danielli, A17-Aframomum melegueta, T18—Thyme, B19---Black pepper, C20---Clappertonia

spices added must have contributed to the moisture of the spicy chocolate. Differences in the moisture contents of other ingredients must have also contributed. According to Fatimah and Ali [8], chocolate moisture content must fall within 0.5 and 1.50% and above which the rheological parameters will be affected and consequently causing difficulty in chocolate flow properties because of sugar agglomeration leading to grittiness in the chocolate and also causing an increase in its viscosity and its yield value. Obatoye, et al. [15] also reported values of moisture content between 0.90-1.2%. The authors opined that the reason for the low moisture contents obtained in their studies was due to the drying levels of all the different ingredients used in the formulation. The % protein obtained in this study was higher than the work of Akinwale [16] who reported a value of 5.25% for soya-fortified chocolate which was lower than the value obtained in black pepper chocolate with protein content of 6.34% in this study. Our findings was in compliance with the work of Fatimah and Ali [8] who reported an increase in % protein as a result of addition of Cinnamon, Aniseed, ginger and lemon peels in their chocolates. Previous reports by Aroyeun and Jayeola [13] showed an increase in % protein content in green tea chocolate with increasing levels of green tea in the formulation. This study however proved the possibility of improvement in %protein contents of chocolates with other additives. The % ash content as reported in this study varied significantly too. The ash contents ranged between 2.27% and 2.76%, the values which were higher than the values reported by Obatoye, et al. [15] when cow milk and soya milk powders were used in the formulation of chocolate. The values obtained in this study predicted the possibility of mineral accumulation in chocolate containing spices. Although the values of the Ash contents of the spicy chocolate samples and the control (C10) fell within the regulated levels of 2.4%, it was evident from our data that some spices resulted in a significantly higher value than the 2.4%

regulatory values for chocolate. This value is different from the values reported by [17] who reported varying ash contents for different chocolate brands purchased in Brazilian Markets. Kharat and Deshpande [18] also reported a lower value of Ash in their probiotic chocolate but a similar percentage value in protein to the values obtained in this study. The percentage fat contents varied significantly according to the type of spice used. However, the different chocolate samples and the control chocolate, C10, contained significantly different percentage levels of fat with a range of values between 31.53 and 34.43%. The increase in fat contents of chocolate as a result of spice additions may be due to the oil composition of the spices coupled with the cocoa butter contents. Most spices have been reported to contain essential oils and as such can contribute to the stability of the chocolate samples The carbohydrate contents of chocolate obtained in this study fell between 47.83 and 51.63% which is not in tandem with the reports of Akinwale [19], who reported carbohydrates contents of chocolate as 26%. Other reports have indicated that the Carbohydrates of chocolate whether dark, milk or white chocolate could be more than this value [13,15,17,20]. The crude fibre of the chocolate varied accordingly and with significant differences. The range of values for crude fibre fell within reported values and it is between 2.35 an0 2.68%. The values obtained were far higher than the one reported by Obatoye, et al. [15] who reported a range of values of 0.86 to 0.98%. It is obvious that the chocolate containing spices can have a health benefit and can serve as a snack that can enhance the health of gastrointestinal tract as it can contribute to easy bowel movement However, the values were within the regulated levels for a standard chocolate.

3.2 Sensory Characteristics of Spicy Chocolates

Table 3 shows the sensory profiles of chocolates produced with the addition of different spices. Taste, Aroma, Texture, Colour and Overall Acceptability were analyzed. The superiority of the control chocolates to other spice supplemented samples were described in all the sensory profiles evaluated. The control chocolates (C10) were rated as high as 8.4, in taste, 7.7 in Aroma, 7.65 in Texture, 7.3 in Color and 8.1 in general acceptability for all the desirable notes in intensity of those attributes respectively. Chocolates supplemented with spices have significant differences at $p<0.05$ in all the attributes evaluated during the organoleptic assessments. A lot of factors might have contributed to this. It could be due to their differences in physical, chemical, biochemical, agronomical and their physiological properties. Of all the spice supplemented chocolates, the sample coded A17 (*Aframomum melegueta* seemed to be closer to the control sample although significantly different in other properties but not in the attributes of Taste, and Aroma with scores of 6.45 and 7.3 respectively. The implication of adding spices to Milk chocolate on the corresponding Total Calorific values of Milk Chocolate was shown in Table 4 with clear changes in the TCV values of chocolates incorporated with different spices in kCal/200 g of the chocolate. The percentage increase or decrease in TCV was observed to be due to spice addition. Chocolates containing *Aframomum danielli* (A17) and the one into which *Aframomum melegueta* powders were added did not show any significant increase in the TCV values when compared to the control. However, black pepper showed a slight decrease in TCV but this was not significant. Other spices resulted in reduction of the TCV of milk chocolates which were in the range of 0.12% by C13 (Clove supplemented chocolate) to the chocolate into which Turmeric powder was added at a percentage reduction in TCV of 54.49. The spices with the reduction in TCV as observed in this study were clearly shown in Table 4 Samples C20, G11, G12, T15, T18, and C14 were responsible for percentage reduction in the TCVsignificantly.

Table 4. Total calorific value of chocolates containing spices and the control (Add standard deviation)

Chocolate	TCV (Kcal100/g)	% changes in TCV
A17	532.34±0.532	1.44
A16	529.3±1.231	0.86
B19	522.31±1.000	0.47
C10	524.78±1.666	----
C13	524.15±0.45	0.04
C20	244.74±1.111	53.36
G11	250.28±1.052	53.07
G12	246.25±1.334	53.08
T15	242.82±1.222	53.73
T18	242.58±1.033	53.77
C14	246.79±0.798	52.97

Legends: C10—Control milk chocolate, G11—Ginger, G12—Garlic, C13—Clove, C14 Cinnamon, T15—Turmeric, A16-Aframomum danielli, A17-Aframomum melegueta, T18—Thyme, B19---Black pepper, C20---Clappertonia

4. CONCLUSION

This study established the possibility of using spices in the formulation of an innovative spicy Milk Chocolates. From our results the addition of spices resulted in an increase in Protein, Fat and reduction in Calories. The sensory evaluation indicated a very acceptable scores for the chocolate into which spices were added which were comparable to the control chocolate without spices.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Angana Borahb, Manabi Pawb, Roktim Gogoib, Rikraj Loyingb, Neelav Sarmab, Sunita Mundaa, Sudin Kumar Pandeya, Mohan Lala. Chemical composition, antioxidant, anti-inflammatory, anti-microbial and *In-vitro* cytotoxic efficacy of essential oil of *Curcuma caesia* Roxb. leaves: An endangered medicinal plant of North East India. Industrial Crops & Products. 2019;129:448-454.
2. Raut J, Karupayil SM. A status review on the medicinal properties essential oils. Industrial Crops and Product. 2014;62: 250-264.
3. Afolabi MO, Adegoke GO. Antioxidative and flavouring effects of *Aframomum danielli.* African Journal of Food Science. 2014;8(4):200-203.
4. Gabriel Olaniran Adegoke, Olaoluwa Ayodele, Ojo. Phytochemical, antioxidants and antimicrobial activities in the leaf, stem and fruits fraction of Basella alba and Basella rubra. Plant. 2017;5:73-79.
5. Soengas P, Cartea ME, Francisco M, Sotelo T, Velasco P. New insights into the antioxidant activity of Brassica crops. Food Chemistry Journal. 2012;134:725–733.
6. Adegoke GO, Skura BJ. Nutritional profile and antimierobial spectrum of the spice *Afi'amomum danielli* K. Schum Plant Foods for Human Nutrition. 1994;45:175-182.
7. Adegoke GO. gabriel olaniran adegoke· ronke gbadamosi felix evwoerhurhoma· phyllis ifeoma uzo-peters kolawole olumuyiwa falade· olu itiola olanrewanju moody. Brent Skura Protection of maize (Zea mays) and soybeans (Glycine max) using *Aframomum danielli.* Eur Food Res Technol. 2002;214:408–411.
8. Fatima, Ali. Development of functional Chocolate with spices and lemon peel powder by using response surface method. Academic Journal of Food Science; 2014.
9. Aroyeun SO. Detection, quantification and reduction of ochratoxin A in cocoa beans and cocoa products. PhD Thesis, University of Ibadan, Nigeria; 2009.
10. Cakil A, Kordali S, Kilic H. Antifungal properties of essential oils and crude extracts of Hypericumlinaroides Bosse. Biological synthesis and Ecology. 2005; 33:245-256.
11. Voda K, BOH B, Vitenik M. Effect of the antifungalactivity of oxygenatedaromatic essential oil compoundson the water rot trametes versicolor and the brown rot Coniophora puteana. International Bio Deterioration and Biodegradation. 2003;51: 51-59.
12. Ormancy X, Sissali S, Coutiese P. Formulation of essential oils in functional perfumery, parfums, cosmetiques, Actualities. 2001;157:30-40.
13. Aroyeun SO, Jayeola CO. Developing a functional food from green tea powder and chocolate and evaluation of its Physical, chemical, total phenolic content and organoleptic properties. Journal of Food Processing/Technology. 2016;7(4): 2-5.
14. AOAC. Official Methods of Analysis, Association of Official Analytical Chemist. EUA; 2000.
15. Obatoye O, Ogunwolu SO, Idowu AA. Quality evaluation of chocolate produced using soy-cow milk. Nutrition and Food Science. 2014;44(1):57-63.
16. Akinwale. Development and organoleptic assessments of soya-fortified chocolate products. European Journal of Food

Research and Technology. 2004;211: 269-271.
17. Rúbia Michele Suzuki, Paula Fernandes Montanher, Jesuí Vergilio Visentainer, Nilson Evelázio de Souza. Proximate composition and quantification of fatty acids in five major Brazilian chocolate brands. Ciênc. Tecnol. Aliment., Campinas. 2017;31(2):541-546.
18. Kharat VT, Deshpande HW. Studies on proximate analysis and microbial analysis of probiotic chocolate. Journal of Pharmacognosy and Phytochemistry. 2017;6(5):407-411.
19. Akinwale T. Development and organoleptic properties of soya fortified chocolate products. European Journal of Food Research and Technology. 2004;211: 269-271.
20. Erikainure OL, Egagah TI, Bolaji PT, Ajiboye AJ. Development and quality assessment of dark chocolate products. American Journal of Food Technology. 2010;5(5):324-330.

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