PRODUCTION AND QUALITY EVALUATION OF MAZARKWAILA FROM SUGARCANE AND COCOA POWDER

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Abstract: Mazarkwaila is solidified syrup that employs an age-long technology. in its production. It is conventionally produced from sugarcane. This study investigates the production of Mazarkwaila from sugarcane and cocoa. Sugar cane was utilized as the main ingredient and cocoa added to provide a nutritional balance. Mazarkwaila was blended with cocoa at different proportion: 0 (control), 2, 3, 4, 6, 8, and 10 respectively. Chemical analysis including theobromine, caffeine, minerals, sugar content and sensory properties was determined using standard procedure. The ash content varies from 0.04 ± 0.01 to 0.90 ± 0.04, pH varied from 5.19 ± 0.17 to 5.56 ± 0.02, total solid were from 0.05 ± 0.03 to 0.29 ± 0.06, Total soluble solid varies from 0.37 ± 0.03 to 0.80 ± 0.30 and moisture varies from 6.06 ± 0.01 to 6.88 ± 0.01 respectively. Theobromine and caffeine content varied from 0.061 ± 0.01 to 0.069 ± 0.01 and 0.013 ± 0.01 to 0.021 ± 0.01 respectively, Fe, Mg, Cu, Zn and P content increased from 0.38± 0.01 to 0.46± 0.01, 0.09± 0.01 to 0.17± 0.01, 0.11±0.01 to 0.18± 0.01, 0.09± 0.01 to 0.19 ± 0.01, 0.02±0.01 to 0.09±0.01, 0.04±0.01 to 0.O7±0.01 respectively. Increase was also observed in the Brix level changed from 92.20 ± 0.01g to 95.11 ± 0.01a, glucose varies from 3.07±0.01a to 3.63±0.01, maltose varies from 3.05±0.01 to 3.59±0.01, fructose varies from 6.30±0.01to 7.23±0.01, sucrose 78.43 ± 0.01 to 80.96 ± 0.01, total sugar varies from 94.34 ± 0.09 to 97.31 ± 0.15. Data collected were subjected to statistical analysis. The results showed that the addition of 4% addition of cocoa sample has a superior effect on the moisture content which prolong shelf life with better sensory properties. Although, that containing 10% cocoa sample, had a higher ash content, total solid and superior value for sucrose content. The result showed that there were significant differences in all properties check with exception of mineral content .From the chemical, sensory, evaluation with other properties in tested in the study. Mazarkwaila with 4% addition of coco a powder was the most preferred.

Keyword: Quality, Mazarkwaila, Sugarcane, Cocoa powder

Introduction

Mazarkwaila is a natural traditional sweetener made by the concentration of sugarcane juice. Is also a solidified syrup that employs an age-long technology, which is far less efficient than both vacuum pan and open pan processes employed in Zaria, Kaduna State of Nigeria and the Mazarkwaila is mostly found in a commercial quantity in the Northern part of the country (NSDC, 2002). Mazarkwaila is also known as Gur in India by The Patent Office Journal (2006). Panela In South American, Others include; Piloncillo-Mixico, Tapa dulci-Costa rica, Namtan tanode- Thailand, Gula Melaka-Malaysia and Kokuto-Japan. Helen (2016). Furthermore, Shakuntala Manay *et al.,* (2008) reported that “Mazarkwaila is also obtained from Palmyra, date palm and coconut”. However, it further explains that the farmers have continued to employ this technology by artisanal sugar producers using a simple crusher consisting of three metal rollers, this is driven by either animal or diesel power. Primarily to perpetuate its inheritance from the parents and also meet the need of the local community at affordable price. The council is conscious of the primary importance of this technology and is giving every encouragement to the farmers to continue in this way but emphasizing the level of hygiene to be observed and assisting to improve the efficiency of the boiling pans which is the bane of the process and hence save fuel during boiling. While ShakuntalaManay *et al.,* (2008) stated that “Mazarkwaila which is produced throughout India, it forms an important item of India diet”. It is mainly obtained from sugarcane. However, its price, shelf life, keeping quality, taste, texture and structure depends upon the sugarcane genotype used for Mazarkwaila making. Mazarkwaila is better than white sugar, because it aid in digestion, provides good amount of minerals and antioxidants such as zinc, selenium which builds strong immune and it also provide energy over an extending period of time. A well matured high sugar recovery cane variety with reasonable juice extraction and purity is pre requisite for a better quality of Mazarkwaila. NSDC (2002) pointed out that “non-sugars affect the quality of product not quantity. With enhanced standard of living and higher income, the Mazarkaila demand has shifted to white sugar. In the manufacture of Marzarkwaila, cane is crushed soon after cutting (within a day) to avoid loss of weight and sugar due to inversion. According to Andrew Russell (1998), those produced directly from the cane juice at the place of origin can be made using relatively low-cost and low technology processes suitable for small-scale production. However, this level of production still requires experience, skill and knowledge to be successful. The technology involved is based on the open pan production which is described in the Practical Action’s technical briefs on Mazarkwaila. Confectionery is essentially a sugar based industry and includes sugar-boiled confectionery (candies or sweet), chocolate confectionery, and others. It is a product liked by all, especially children. Flavonoids are part of a group of antioxidants known as polyphenol which fights cancer, heart disease and aging through it antioxidant boosting effect, other health benefits include; increasing blood flow to the arteries, reducing the risk of blood dots, lower high blood pressure and it provides essential nutrient such as calcium and potassium (Elson, 2006). Therefore, cocoa is one of the cash crop that is of economic important as a raw material to the manufacturing of Marzarkwaila,and in the marketing and processing reduces the rate of unemployment in the area of cultivation (Olajuyin, 2015). It further stated that "it is the major export crops and it's a source of revenue to the Government and source of income to the farmers". Is in formation on the production of Mazarkwaila sweet from the addition of cocoa to the native Mazarkwaila remained scarcity in literature. Therefore, the study attempted to investigate the production and quality evaluation of Mazarkwaila sweet from Mazarkwaila and cocoa powder at different blends.

Materials and Methods

Experimental Location

This study was carryout in the department of Food Science and Technology, School of Agriculture and Agricultural Technology, Modibbo Adama University of Technology (MAUTECH) Yola Adamawa State.

Research Materials

The raw materials used were sugar cane and cocoa powder, produced by Chivico Bakers Company Lagos. All sample materials were stored in a dry environment and reagent used were of analytical grade.

Sample Preparation

Sugarcane juice preparation; it involve the following; cleaning of the sugarcane by washing using clean water and scraping the surface with knife and it was rewashed, size reduction by cutting into segments with knife. Cocoa powder preparation; 180 g of cocoa powder was weighed and then in dissolved in 271 ml water.

Experimental Design

Mazarkwaila was produced using sugar cane syrup and addition of cocoa powder.

Treatment formulation Mazarkwaila-cocoa blends

Sample	Mazarkwaila (g)	cocoa (g)
A	100	0
B	100	0
C	98	2
D	96	4
E	94	6
F	92	8
G	90	10

The sample A is the market sample and sample B which is the Laboratory prepared sample where the

Mazarkwaila Production

The process was carried out as described by NSDC (2002). The sugarcane top and root were removed. The size of the sugarcane was reduced into smaller pieces after peeling to speed up the juice extraction process, using the screw presser, at an ambient temperature and pH of the juice was 5.03, which was done for so many portions. It was then filtered using fine sieve and smaller sugarcane particles were removed. Whereas, 4.0kg of the juice was extracted and having 5.6kg of cane fibers (including the peels of the sugarcane) and 15% soluble solid. Which took about 6hours extraction time and the sucrose, glucose, fructose obtained was; 85%, 6%, 3% respectively. The juice was divided into 7 portions. Cocoa solution was then added to each of the portions of sugarcane juice extracted in 2% cocoa : 98% juice, 4% cocoa : 96% juice, 6% cocoa : 94% juice, 8% cocoa : 92% juice, 10% cocoa : 90% juice. It was crushed to extract the juice which was and then boiled to evaporate excess water to a brix of 80 degree at this point, cocoa mixture was added then mixed thoroughly and it was allowed to concentrate into syrup at final temperature 140 ^{0}C for about 15minutes. Therefore, the remaining "syrup" was scoped into an earthen clay pot where it was stirred for air cooling. The "syrup" was sufficiently cooled. It was then scooped into moulds and allowed to solidify at room temperature. The solid sugar that is known as Mazarkwaila fortified with cocoa is removed from the mould.

Results and Discussion

Chemical Composition of Mazarkwaila with Different Concentration of Cocoa Powder

The chemical composition of Mazarkwaila with different concentration of cocoa powder is presented in table 3. The result shows that there were significant differences in all the parameter tested. The ash content varies from 0.04±0.01 to 0.90±0.04, the highest Ash content is recorded from sample G and the lowest from sample B. the result didn't agrees with the findings of FSDA (2017) stated the level of ash content to be 0.2%, it's a chocolate sweet containing at least 60% of chocolate by weight), which is slightly lower, it may be due to varietal and formulation differences and ingredients used. Other worker Asokan (2007) reported a slightly higher value 1% than the one reported in this study. It was observed that the ash content increase with increase with increase with cocoa level. This increase is a common phenomenon in supplementation process because of the increase of minerals from cocoa powder. The ash content increases along the group apart from sample D, which may be due to the error of experiment. It also shows that there was no significant difference at ($p \leq 0.05$) for the commercial and laboratory prepared without cocoa added, but a significant difference at ($p \leq 0.05$) was observed for the rest of the samples.

The quantity of the juice extraction is low and the time, was 4.0kg for 6hrs extraction time. Sediment was observed to have settled to the button of the pot during the boiling and it was dredged out and also scum rises to the top, was also skimmed off. Each of the process took about 34 minutes to evaporate at constant temperature from 100% of sugarcane juice to about 20% concentration as stated in Kaplinsky (1989). During the concentration, it was observed that the color changes from transparent liquid to brown as a result of caramelization process as mentioned in Dannis (1993) and deeper brown as cocoa was being added.

The pH content varies from 5.19±0.01 to 5.56±0.02, the highest pH content is recorded from sample F and the lowest from sample D. The result didn't agrees with the result of Unde *et al.* (2011)

Table 3: Chemical composition of the Mazarkwaila with different concentration of cocoa

Samples	Ash %	pH	Total solid%	Total soluble solid %	Moisture %
A	0.05 ± 0.01[f]	5.52 ± 0.03[ab]	11.05± 0.03[a]	0.37 ± 0.03[a]	8.12 ± 0.02[a]
B	0.04 ± 0.01[f]	5.45 ± 0.01[ab]	11.11±0.05[bc]	0.54 ± 0.32[b]	6.18 ± 0.01[e]
C	0.06 ± 0.01[e]	5.22 ± 0.17[c]	11.15±0.07[bc]	0.43 ± 0.74[c]	6.51 ± 0.02[f]
D	0.80 ± 0.01[d]	5.19 ± 0.17[bc]	11.18± 0.28[b]	0.62 ± 0.30[d]	6.06 ± 0.01[d]
E	0.44 ± 0.01[c]	5.50 ± 0.13[ab]	11.22± 0.10[c]	0.64 ± 0.04[d]	6.09 ± 0.05[f]
F	0.76 ± 0.01[b]	5.56 ± 0.02[ab]	11.25± 0.08[c]	0.80 ± 0.30[e]	6.88 ± 0.01[b]
G	0.90 ± 0.04[a]	5.39 ± 0.01[a]	11.29± 0.06[d]	0.77 ± 0.12[d]	6.76 ± 0.01[c]

Means in the same column bearing different superscript are significantly different at $p<0.05$

Key: A =Market sample (100% Mazarkwaila), B =Laboratory prepared sample (100% Mazarkwaila), C = (Mazarkwaila 98% to 2% Cocoa), D = (Mazarkwaila 96% to 4% Cocoa), E = (Mazarkwaila 94% to 6% Cocoa), F = (Mazarkwaila 92% to 8% Cocoa), G = (Mazarkwaila 90% to 10% Cocoa)

That the pH varies from 6.60% to 6.0% during storage Mazarkwaila sweet is slightly higher than the one reported in this study. This may be due to varietal and ingredients difference. It was observed that there was no progressive increase, which may be due to error due to experiment.

The total solid varies from 11.05±0.03 to 11.29±0.06, the highest value is recorded from sample G and the lowest from sample A. the results agrees with the findings of STAI (2017) having the total solid of Mazarkwaila ranging from 8 to 12%, which explains that the value depends on the total solids in cane. Along the group there was increased with increase with cocoa level. Cocoa powder tends to float on the surface of a liquid. Total soluble solid varies from 0.37±0.03 to 0.80±0.30, the highest total soluble solid is recorded from sample F and the lowest from sample A. it was observed that the total soluble solid increases along the group apart of sample G, which shows a slight decrease due to error during experiment.

The moisture content varies from 6.06±0.01 to 8.12±0.02%, the highest moisture content is recorded from sample A and the lowest from sample D. The results agrees with the findings according to Kaplinsky (1989) stated that the moisture content of Mazarkwaila ranges from 6.0% to 9.0%. However, ISJ (1995) added that when the moisture content is lower it will be very hard to break and chew, though its shelf life will be extended and when it’s higher above the range its shelf life under adequate condition is from 1 to 2 months.

Theobromine and Caffeine levels in Mazarkwaila supplemented with Cocoa powder

The Theobromine and Caffeine levels in Mazarkwaila supplemented with Cocoa powder is presented in Table 4. The result shows that there were not significantly differences in all the parameter tested. The theobromine content varies from 0.61±0.01 to 0.069±0.01. The highest theobromine content is recorded from sample G and the lowest from sample C. the result does not agrees with the findings of According to Matissek (1997), the average content of cocoa solid in milk chocolates is lower (15.7%) than the average content of cocoa solid in bittersweet chocolate and dark chocolate (61.7% and 39.6% respectively), this were sample that about 80% cocoa based sweet compared with the one used in this study. Matissek R (1997) further reported

Table 4; Theobromine and caffeine levels in Mazarkwaila

Sample	Theobromine mg/ml	Caffeine mg/ml
A	-	-
B	-	-
C	0.061 ± 0.01[a]	0.013 ± 0.01[a]
D	0.063 ± 0.01[a]	0.015 ± 0.01[a]
E	0.064 ± 0.01[a]	0.017 ± 0.01[a]
F	0.066 ± 0.01[a]	0.019 ± 0.01[a]
G	0.069 ± 0.01[a]	0.021 ± 0.01[a]

Means in the same column bearing different superscript are significantly different at $p<0.05$

Key: A =Market sample (100% Mazarkwaila), B =Laboratory prepared sample (100% Mazarkwaila), C = (Mazarkwaila 98% to 2% Cocoa), D = (Mazarkwaila 96% to 4% Cocoa), E = (Mazarkwaila 94% to 6% Cocoa), F = (Mazarkwaila 92% to 8% Cocoa), G = (Mazarkwaila 90% to 10% Cocoa).

That the difference in theobromine and caffeine levels in chocolate was influenced more by the type of cocoa beans than the cocoa content itself. it was observed that the theobromine content increased with increase with cocoa level. The increase is due to the increase of the cocoa powder level and it was also observed that there were no value recorded for the sample A and sample B, it may be due to the absent of cocoa powder in the sample. Due to the fact that that pure sugar cane juice does not contained theobromine as described by Jagannadha *et al.,* (2007). Whereas, the value of caffeine ranges from 0.013mg/ml representing sample C to 0.021 representing sample G. it was observed that the caffeine content increased with increased with cocoa level. The increase is due to the increase in the cocoa powder level and it was observed that there were no value recorded for the sample A and sample B, it may be due to the absent of cocoa powder in the sample. Due to the fact that that pure sugar cane juice does not contained caffeine as described by Jagannadha *et al.,* (2007).

However, it was found that theobromine and caffeine content in local white chocolates sources ranges from 0.0728 — 0.028mg/ml. therefore showing that the result obtained are within 0.061-0.021mg/ml. Furthermore, theobromine content in sample A and sample B containing no cocoa powder was found to be non-detectable. Ingredients in milk chocolate such as almonds; peanuts and raisin decrease theobromine and caffeine compound levels, whereas this product contains only sugar cane and cocoa powder. Thereby, the level of decreased in the percentage may not be observed. Furthermore, the higher level of theobromine in sample G could have been caused by the higher content of cocoa powder in the mazarkwaila compared to the sample C that is having fewer amounts. Thus the lack of significant differences in theobromine levels in sample C, D, E, F and G could be due to the use of the same type of cocoa powder and also due to the cocoa powder concentration of the samples. These results show that imported chocolates contain higher theobromine and caffeine levels compared to local chocolates. This could be due to the use of higher amounts of cocoa powder in imported chocolates than in local chocolates. Moreover, the species of cocoa beans used by overseas.

Mineral Content of Mazarkwaila Sweet Supplemented With Cocoa Powder

The mineral content of Mazarkwaila sweet supplemented with cocoa powder is presented in table 5. The result shows that there were not significantly different in all the parameter tested. The Calcium content varies from 0.38±0.01 to 0.46±0.01. The highest calcium content recorded from sample G and the lowest from sample A.

Table 5, Mineral analysis of the Mazarkwaila sweet

Sample	**Ca ppm**	**Fe ppm**	**Mg ppm**	**Cu ppm**	**Zn ppm**	**P ppm**
A	0.38 ± 0.01^a	0.09 ± 0.01^a	0.11 ± 0.01^a	0.09 ± 0.01^a	0.02 ± 0.01^a	0.04 ± 0.01^a
B	0.40 ± 0.01^a	0.14 ± 0.01^a	0.14 ± 0.01^a	0.18 ± 0.01^a	0.02 ± 0.01^a	0.03 ± 0.01^a
C	0.39 ± 0.01^a	0.11 ± 0.01^a	0.10 ± 0.01^a	0.15 ± 0.01^a	0.03 ± 0.01^a	0.04 ± 0.01^a
D	0.40 ± 0.01^a	0.13 ± 0.01^a	0.12 ± 0.01^a	0.13 ± 0.01^a	0.02 ± 0.01^a	0.04 ± 0.01^a
E	0.43 ± 0.01^a	0.14 ± 0.01^a	0.15 ± 0.01^a	0.14 ± 0.01^a	0.05 ± 0.01^a	0.04 ± 0.01^a
F	0.45 ± 0.01^a	0.16 ± 0.01^a	0.16 ± 0.01^a	0.16 ± 0.01^a	0.06 ± 0.01^a	0.05 ± 0.01^a
G	0.46 ± 0.01^a	0.17 ± 0.01^a	0.18 ± 0.01^a	0.19 ± 0.01^a	0.09 ± 0.01^a	$0.O7\pm0.01^a$

Means in the same column bearing different superscript are not significantly different at $p<0.05$

Key: A =Market sample (100% Mazarkwaila), B =Laboratory prepared sample (100% Mazarkwaila), C = (Mazarkwaila 98% to 2% Cocoa), D = (Mazarkwaila 96% to 4% Cocoa), E = (Mazarkwaila 94% to 6% Cocoa), F = (Mazarkwaila 92% to 8% Cocoa), G = (Mazarkwaila 90% to 10% Cocoa)

The result agrees with the findings of. Jakannadha *et al.* (2007) who reported that calcium values ranges from 40-100mg of Mazarkwaila. The differences may be due to the different species of the raw material used. it was observed that the Calcium increase with increase with cocoa level. The increase maybe due to the minerals from cocoa powder The mineral content increases along the group apart from sample C at the calcium level. It also shows that there was no significant difference at ($p \leq 0.05$) for the commercial and laboratory that are not having cocoa powder added, and no significant difference at ($p \leq 0.05$) was observed for the rest of the samples.

The value of Fe content ranged from 0.09ppm representing sample A to 0.17ppm representing sample G. this result does not agrees with findings of Luciano (2016) reported on chocolate that the Fe ranges from 1.0-9.0mg. The difference may be due to the different species of sugar cane and cocoa used or even other ingredients used. it was observed that the Fe content increased with increase in cocoa powder level apart from sample B, which may be due to the experimental error. This increase is a common phenomenon in supplementation process because of the increase of the cocoa powder addtition.

The value of Magnesium ranged from 0.10ppm representing sample C to 0.18ppm representing sample G. it was observed that magnesium content increase with increase with cocoa powder level. This increase is due to the addition of cocoa powder level, because cocoa powder has considerable amount of minerals as stated by Jakannadha *et al.*, (2007).

The value of copper ranged from 0.09ppm representing sample A to 0.19ppm representing sample G. The results agrees with the findings of Luciana *et al*., (2016) mentioned that copper ranges from 0.1 to 0.98mg of chocolate sweets (chocolate liquor, sugar, added cocoa butter, and vanilla beans, vanillin, salt, spices, and essential oil) it was observed that the copper content increase with increased cocoa powder. it may be due to the increased of the cocoa powder, since it has appreciable amount of minerals as stated by Jakannadha *et al.*, (2007). This can be compared with the result obtained of the copper.

The value of Zinc ranged from 0.02ppm representing sample A to 0.09ppm representing sample G. it was observed that the Zinc content increase with increase cocoa powder. It may also be due to the increase of the cocoa powder.

Table 6: sugar analysis of the Mazarkwaila with different concentration of cocoa

Samples	Brix %	Glucose%	Maltose%	Fructose%	Sucrose %	Total Sugar %
A	92.85 ± 0.01^{e}	$3.07{\pm}0.01^{a}$	$3.05{\pm}0.01^{a}$	$7.30{\pm}0.01^{g}$	79.43 ± 0.01^{g}	94.34 ± 0.09^{d}
B	94.03 ± 0.01^{b}	$3.32{\pm}0.01^{g}$	$3.43{\pm}0.01^{c}$	$7.04{\pm}0.01^{e}$	80.24 ± 0.01^{e}	96.44 ± 0.02^{c}
C	94.06 ± 0.01^{b}	$3.41{\pm}0.01^{c}$	$3.45{\pm}0.01^{c}$	$7.09{\pm}0.01^{c}$	80.11 ± 0.01^{f}	96.36 ± 0.04^{c}
D	94.46 ± 0.01^{b}	$3.51{\pm}0.01^{e}$	$3.52{\pm}0.01^{e}$	$7.12{\pm}0.01^{c}$	80.31 ± 0.01^{d}	96.97 ± 0.03^{b}
E	94.79 ± 0.01^{b}	$3.55{\pm}0.01^{d}$	$3.55{\pm}0.01^{e}$	$7.15{\pm}0.01^{f}$	80.54 ± 0.02^{c}	96.83 ± 0.03^{b}
F	95.10 ± 0.01^{a}	$3.57{\pm}0.01^{c}$	$3.58{\pm}0.01^{e}$	$7.19{\pm}0.01^{d}$	80.76 ± 0.01^{b}	97.31 ± 0.15^{b}
G	95.41 ± 0.01^{a}	$3.63{\pm}0.01^{b}$	$3.59{\pm}0.01^{g}$	$7.23{\pm}0.01^{a}$	80.96 ± 0.01^{a}	96.88 ± 0.01^{a}

Means in the same column bearing different superscript are significantly different at $p<0.05$

Key: A =Market sample (100% Mazarkwaila), B =Laboratory prepared sample (100% Mazarkwaila), C = (Mazarkwaila 98% to 2% Cocoa), D = (Mazarkwaila 96% to 4% Cocoa), E = (Mazarkwaila 94% to 6% Cocoa), F = (Mazarkwaila 92% to 8% Cocoa), G = (Mazarkwaila 90% to 10% Cocoa)

The value phosphorus ranged from 0.04ppm representing sample A to 0.07ppm representing sample G. the results doesn't agrees with the findings of Jakannadha *et al.* (2007) stated the amount of Phosphorus in cocoa powder ranging from 20-90mg, the difference may be due to the varietal difference and formulations. The increase in formulations of cocoa is capable of raising the quantity of phosphorus in proportion to the increasing level it was observed that the Phosphorus contend tends to increase with cocoa powder. it may be because of the increase of the cocoa..

In recent years, various handicraft companies are trying to buy the cocoa beans directly from the producers. In this context, our goal is to contribute to characterize the different raw materials (here, the minerals present). The human body utilizes minerals for the proper composition of the bone and blood and maintenance of the normal cell function. Calcium, the most abundant mineral in the body, is required for vascular contraction and vasodilatation, muscle function, nerve transmission, intracellular signaling and hormonal secretion. The Mazarkwaila fortified with cocoa powder which has some reasonable amount of calcium as obtained from the research conducted, based on the amount of cocoa powder used, because cocoa is rich natural sources of calcium (Borchers *et al*., 2000). Carnovale & Marletta (2001) reported that the foods rich in protein are a good source of phosphorus. The cocoa powder is a good source of phosphorus, providing on an average about 200 mg/100 g of protein and its concentration increases with cocoa percentage. Iron is a mineral essential for life and deficiency of Fe in the body could result in anemia, among nutrients important to feed babies and small children, chocolate contained significantly more Fe (25 mg/100 g) than milk, honey and eggs (Falandysz & Kotecka 1994). The iron content of cocoa is higher than the level found in other foods as beef or chicken liver (Paoletti *et al.* 2012). The bioavailability of iron is quite higher in chocolate with respect to other vegetables, because of low levels of phytic acids therein. The samples of chocolate at 80% and 90% cocoa are an excellent source of Iron confirming the upward trend of the content of iron by increasing the percentage of cocoa. Zinc

Table 7: Sensory evaluation result

samples	Texture	Colour	Taste	Flavor	Overall acceptance
A	4.63 ± 0.35^{b}	4.58 ± 0.36^{b}	4.37 ± 0.29^{c}	4.47 ± 0.31^{c}	4.74 ± 0.32^{c}
B	4.37 ± 0.31^{b}	4.37 ± 0.28^{b}	4.95 ± 0.25^{bc}	5.00 ± 0.28^{bc}	4.90 ± 0.22^{c}
D	5.68 ± 0.20^{a}	5.63 ± 0.22^{a}	5.47 ± 0.23^{ab}	5.58 ± 0.21^{ab}	5.52 ± 0.19^{b}
C	4.84 ± 0.28^{b}	4.42 ± 0.35^{b}	4.47 ± 0.23^{c}	4.79 ± 0.18^{c}	4.84 ± 0.16^{c}
E	4.58 ± 0.21^{b}	4.90 ± 0.17^{ab}	4.68 ± 0.23^{c}	4.74 ± 0.30^{c}	4.95 ± 0.24^{bc}
F	4.53 ± 0.27^{b}	4.42 ± 0.3^{4b}	4.58 ± 0.26^{c}	4.79 ± 0.24^{c}	4.47 ± 0.19^{c}
G	4.32 ± 0.35^{b}	4.11 ± 0.28^{b}	4.68 ± 0.23^{c}	4.32 ± 0.32^{c}	4.68 ± 0.20^{c}

Means in the same column bearing different superscript are significantly different at p<0.05

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has a considerable influence on the immune system and the lack of this mineral causes atrophy of lymphoid organs (Tuerk & Fazel 2009). Zinc nutritional deficiency is a global health problem (Osendarp *et al*. 2003). The content of zinc in the chocolate with 90% cocoa contributes approximately one third of the nutritional requirement by consuming 100 g of such product.

Sugar Content of the Mazarkwaila Sweet Supplemented With Different Concentration of Cocoa Powder

The chemical composition of Mazarkwaila with different concentration of cocoa powder is presented in table 3. The result shows that there were significant differences in all the parameter tested. The brix content was observed that the lowest value is sample A92.85 ± 0.01^{g} and sample G 95.41 ± 0.01 is the highest. The results agrees base on the research conducted by ISJ (1995) the standard characteristic value of the brix is between 92 and 95%. Lynn (2011) and further reported that brix equals the pounds of sucrose, fructose, vitamins, minerals, amino acids, proteins, and other solids and it further show that high brix reading equate with superior nutrient content. For glucose varies from 3.07±0.01 to 3.63±0.01, maltose varies from 3.05±0.01 to 3.59±0.01, fructose varies from 7.04±0.01 to 7.30±0.01, sucrose 78.43 ± 0.01 to 80.96 ± 0.01, The sucrose content of the Mazarkwaila of different samples was observed to be increasing along the group, and sample A 78.43 ± 0.01 was found to be the lowest, whereas sample G 80.96 ± 0.01 is the highest. The slight increase may be due to the increase in the cocoa addition in increasing proportion.

Mendham (2000) stated that Sugars are members of the carbohydrate family. Examples include glucose, fructose and sucrose. Sucrose is the most common non-reducing sugar. The linkage between the glucose and fructose unit in sucrose, which involve aldehyde and ketone groups, is responsible for the inability of sucrose to act as a reducing sugar. Some sugars can act as reducing agents and these sugars will contain an aldehyde functional group.

Sensory Evaluation of Mazarkwaila with Different Concentration of Cocoa Powder

The chemical composition of Mazarkwaila with different concentration of cocoa powder is presented in Table 3. The results for texture varies from 4.32±0.35 to 5.68±0.20, colour varies from 4.11±0.28 to 5.63±0.22, taste varies from 4.37±0.29 to 5.47±0.23, flavor varies from 4.32±0.32 to 5.58±0.21 showed that there were significant difference in all the parameter tested at ($p \leq 0.05$) in terms texture, color, taste, flavor and overall acceptance. The result shows that for all the organoleptic properties considered, 4% Cocoa addition sample and the sample was sample was superior to all the other samples from other treatments in terms of flavor, taste, color, and general acceptability at ($p \leq 0.05$). Sample F and G are having a more of chocolate sweet texture and taste, which was due to the high amount of cocoa concentration. It tends to disappearing the real taste and texture of Mazarkaila sweet completely. Therefore, sample C and D still retains the Mazarkaila taste, texture, color and also flavor which agrees with the findings of Kaplinsky (1989) that Mazarkaila sweet is having a more coarse like kind of texture (biscuit texture), some are light brown, dark brown and some may contain particles of sugar cane bagash particles, which depends on the methods and process of production of the Mazarkwaila sweet and also the species of the sugar cane itself. Whereas, sample E is having more of chocolate sweet taste, texture and color, but very little feel of Mazarkaila taste.

Conclusion and Recommendation

Conclusion

From this study the 4% cocoa addition sample had a superior value for the organoleptic properties in terms of flavor, taste, color, and general acceptability and it was found to be comparable with chocolate sweet sample. Therefore, sample D ((Mazarkwaila 96% to 4% Cocoa) would be considered to be best based on the result of the aforementioned parameters observed in the study it has maintained the texture and still retains the Mazarkwaila taste.

Recommendation

Based on the findings of this research, the following recommendations are hereby put forward;

- Improving Mazarkwaila with the addition of clarifiers
- The color should be determine
- Impurities should be check upon

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