PRODUCTION AND EVALUATION OF MALT DRINK FROM THE BLENDS OF SORGHUM AND MILLET

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Abstract: The local sorghum and millet were bought from Girei market of Adamawa state, Nigeria. The grains were cleaned, sorted and steeped in water for 24 h. and allowed to germinate for four (4) days. The shoots and roots of the germinated grains were removed after drying using hot air oven by hand rubbing and winnowing. Coarse grains were obtained by grinding the grains. Six (6) different non-alcoholic malt drinks were prepared from the blends of sorghum and millet in the following ratio 70:30, 30:70, and 50:50 using sorghum and millet adjuncts for each set. The malt was produced using Schmitz process. The malt drink produced was compared to two commercial malt (Gold-malt and Maltina). Physico-chemical analysis of the six (6) malts produced were found to be slightly acidic with pH value of 4.36 – 5.56, while that of the commercial malt to be 5.28 and 5.40. The percentage total solid ranged from 7.04 – 16.66, and that of the commercial malts were 15.14 and 15.26. The total soluble solid (% brix) ranged from 6.03 – 11.50, while that of the commercial malt were 13.07 and 13.1. The titrable acidity (%citric acid) ranged from 0.08 – 0.2, while that of the commercial malts were 0.16 and 0.14. The specific gravity of the malts ranged from 1.02 – 1.05, and that of commercial malts were 1.07 and 1.05. The viscosity (mm^2/s^2) of the malt samples ranged from 1.21- 4.40, while that of the commercial malts were 1.38 and 1.40. Foam capacity of the malt samples ranged from 10 – 50, while that of the commercial malts were 60 and 40. The vitamin C (mg/100ml) of the malt samples ranged from 0.07 – 1.8, while that of the commercial malts were 2.76 and 3.66. The microbial count per ml (cfu/ml) of the malt samples ranged from 0.31 – 1.71. Some of values obtained were found to be slightly higher than the commercial malt samples. The data obtained were subjected to statistical analysis using SPSS. The results showed that there was significant difference observed at ($p<0.05$) obtained between the laboratory prepared malt sample and the commercial malt samples. From the results of physico-chemical, vitamin C, microbial and sensory attributes Sample (A) performed optimally and was found to be superior to other malt samples and rated best.

Keywords: Blends, malt, millet, production, sorghum

Introduction

The production and consumption of non-alcoholic beverage have assumed alarming dimension in the world. Beverages are food that can be distinguished by its principal characteristics from other foods. First they are liquids that are consumed in liquid state and secondly, they are either consumed for their thirst quenching properties or for their stimulating effect (Thekororonye *et el.,* 1995). Malting process involves soaking, germinating and drying, which aims at changing grain into malt with enzymes and vitamin contents. Malting process in sorghum grain induces important beneficial biochemical changes. Indeed, soaking increases water availability and soften the grain (Hounhouigan *et al*, 2012). By improving phytase activity, malting process reduces the phytate level of grain and improve iron (Traore' *et al*, 2003), the tannin level and total phenol content are reduced during germination. And also, the vitamin content increase appreciably (A, B, C and E) (Taur *et al.*, 1984).

However, during malting, dhurrine is hydrolysed to produce cyanogenic acid that is accumulated into the rootlets especially in sorghum. Furthermore, some minerals are lost and this could be as a result of solubilisation and leaching during soaking and utilization of inorganic ions by rootlets during breathing (Hounhouigan *et al.*, 2012). Thus, the malt obtained is one of the raw materials used to prepare different alcoholic and non-alcoholic beverages one of which is the non-alcoholic malt drink popular around the world by its trade name Malt (Okonkwo and Ogbuneke, 2011). In the past, malt drink was use as food for the sick and children, but has since been consumed conventional as beverage by all people. Malt base drinks have now advanced progressively over the years for their nutritional benefit (Obuzor and Ajaezi, 2010).

Majority of studies were carried out on malt drinks produced from either sorghum or millet. This research aim at blending the malt of sorghum and millet to produce malt drink and also to compare the physicochemical properties, nutritional content, microbial load and the acceptability of the produced malt and that of the commercial malt drink in the market.

Materials and Method

Local sorghum and millet was obtained from Girei, Adamawa state, Nigeria. And they were carefully sorted to remove foreign particles, stones and broken ones. 100 grains of sorghum and millet were picked separately and the percentage germination was determined by placing the grains on a filter paper in a petri dish, water was sprinkle on the grain and the petri dish was covered and kept in a dark cupboard. Water was sprinkle on the grain after 12 h interval while the germinated grains were counted after 24 h for 4 days.

Production of sorghum and millet malt flour

Sorghum and millet were weighed (400 g each) and steeped with water the ratio of (1:3 w/v) in separate containers for 6 h and air rested for 1 h. The second steeping was done for 6 h with addition of 1% sodium hypochlorite. The grains were rinsed with clean water and then spread on a damped jute bags and germination was carried out for 96 h at 28 – 30℃. The germinated grains were dried in a hot air oven for 24 h at 50℃. The dried malt was clean of sprouts by hand rubbing and winnowing. The dried malts were milled using attrition mill, the flours from malted milled sorghum and millet were blended in the ratio of sorghum to millet (70:30, 30:70, 50:50) using sorghum adjunct and millet to sorghum (70:30, 30:70, 50:50) using millet adjunct.

Caramel color was prepared by weighing 200 g of granulated sugar; 100 mls of water was mixed with the sugar to get syrup. The mixture was heated gently to boil. 6 mls of ammonium sulphate was added followed by continuous stirring to prevent formation of lumps. Heating continued until the required brown color and the desired consistency was achieved. It was cooled and kept until use.

Production of malt drink

The production of malt drink was carried out by mashing the blended sorghum and millet malt grit at temperature 60℃ for 15 min after mixing with 1.5 ltrs of water to form slurry and the slurry was allow to rest for about 30 min, Afterward the top was decanted into a separate container.

The adjunct grits (45 g) was boiled for 20 min with continuous stirring. The grits is cooled to 65℃; rice hull was added followed by the addition of the thin-wort containing enzyme back into it. The temperature was raised to 75℃ for saccharafication to take place and the temperature was maintained for 30 min, and then it was allowed to rest for 20 min and then the separation of the sweet wort from the grain particles was carried out using cheese cloth and sparged to remove the remaining wort present. Then, the temperature of the wort was raised to 75℃ and gradually to boiling. 8 g of granulated sugar was added, 30 g of caramel was added to improve the color while 0.05 g of citric acid was added to prevent attack from fungi. The bottles were rinsed with hot water and the malt was filled and cork.

Table 1: Recipe for malt production

Ingredients	Quantity (g)
Malted sorghum/millet	100
Sorghum grits	45
Millet grits	45
Water	2.3 litres
Rice hull	15
Caramel	30
Citric acid	0.2
Potassium metabisulphite	0.05

Source: Hinterding (2004)

Wort analysis

Analysis of wort quality was carried out by determining the total solids and the total soluble solids by hot water extract.

Physico-chemical analysis of the malt drinks

Physico-chemical analysis of the malt drinks was carried out (pH, total solids, total soluble solids, titrable acidity, viscosity, specific gravity and foam capacity) and then compared to the commercial malt (Maltinaand Goldmalt). Vitamin C and microbial load was also determined to check the commercial sterility.

Sensory evaluation

The sensory evaluation was carried by using Hedonic test to evaluate the quality of the malt samples as described by (Ihekoronye, 1999). Eight (8) malt samples coded A-H were provided to the panelist and ask to evaluate and score each samples on the basis of some specific parameters based on their preference, by observing the appearance, color, taste, flavor and overall acceptability of the malt drink. The scoring was based on a 7-point hedonic scale ranging from 1 (extremely dislike) to 7 (extremely like) and 4 (neither like not dislike).

Statistical analysis

The general linear model of SPSS statistical package was used for the statistical analysis of results. All the results obtained from the statistical analysis were subjected to analysis of variance (ANOVA) to determine the difference within the samples (Snedecor and Cochran, 1987) and Duncan multiple Range Test (Duncan, 1955) was used to determine the difference within the variation at 95% confidence level ($p \leq 0.05$).

Results and Discussion

The water content of the grains increased after 24 h which was evident by the proper germination of the grains. Sprinkling of the water after 12 h helps the grains not to dry out and it aids in the germination (Table 2).

Table 2: The percentage germination of sorghum and millet samples

Samples	Percentage Germination
Sorghum	96%
Millet	94%

Table 3: Total solids and total soluble solids of Wort (Malt extracts)

Malt samples	%TS	%TSS
A	8.12±0.03^b	2.90±0.10^a
B	8.48±0.01^c	3.20 ± 0.14^b
C	9.37±0.02^d	3.93 ± 0.06^c
D	8.25±0.02^b	2.70 ± 0.02^a
E	7.93±0.53^a	2.77± 0.06^a
F	9.66±0.25^e	4.0 ± 0.01^c

Means in the same column bearing different superscript are significantly different at P<0.05; TS = Total Solids; TSS = Total Soluble Solids

Total solids and total soluble solids of Wort (Malt extract)

Table 3 showed that there were significant differences ($P \leq 0.05$) observed in total solids and total soluble solids of the wort. The total solids content of the wort varied from 7.93-9.66%, while total soluble solid varied from 2.70-4.0%. The highest total solid was recorded from sample F (9.66%) and total soluble solid from sample F (4.0%). While the lowest total solids was recorded from sample E (7.93%) and total soluble solid from sample D (2.70%). It was observed that total solids content is generally higher than total soluble solid content.

Physico-chemical composition of malt drinks

The results of the physico-chemical properties of the malt drink showed that there were significant differences ($p \leq 0.05$) observed in the pH, total solid, total soluble solid titrable acidity, viscosity and foam capacity. The specific gravity for the samples were not significantly different.

The results showed that the pH of the malt samples were found to be slightly acidic. It ranged from 4.34-5.56 with sample C having the highest value while sample E the lowest value (Table 4). The pH values were observed to be comparable to that of the commercial malt drink. The pH values are slightly lower to the ones reported by Abdel *et al*. (2017) with the range 6.43, 6.39. Akonor *et al*. (2014) reported a range of pH value of malt drink produced from roasted maize from (5.01-5.21) and Obuzor and Ajaezi (2010) also reported that of some commercial carbonated malt beverage (4.4-4.6).

The percentage total solid content of the blended samples ranged from (7.04-16.6%). The highest value was recorded from sample A (16.6%) and the lowest from sample D (7.04%). Hosseini *et al.* (2012) report a lower value of (5.38%). The observed higher value of the total solid could be attributed to lack of efficient filtration as well as formulation ratio. The total solid content represents both soluble and insoluble material in the malt drinks.

The percentage total soluble solids of malt drink ranged from 6.03-11.5%. Sample A recorded the highest percentage total soluble solid content (11.5%). While sample E recorded the lowest value (6.03%) . the percentage total soluble solid of malt drink samples were observed to be higher than that of their corresponding wort (malt extract). This is as a result of additives added to the product. In addition, the percentage total soluble solid content of the commercial malt drink was observed to be higher than that of the malt samples. The higher value observed for the commercial malt drink could be attributed to high filtration technique and filter used in the industries. However, the result as indicated showed the total soluble solid for sample A is closer to the control than other malt drink samples. The percentage total soluble solids in food drinks represents the dissolved solids as sugar.

The percentage total soluble solid obtained from the blended malt drink agrees with the findings reported by Akonor *et al*. (2014). It was reported that the percentage total soluble solid ranged from (3.2-12.3%).

The percentage titrable acidity of the malt samples produced from the blends of sorghum and millet range from 0.08-0.2%. The highest percentage titrable acidity was recorded from sample A (0.2%) and the lowest from sample D (0.08%). The percentage titrable acidity for the blended samples were found to be comparable to that of the control. The values obtained for the percentage titrable acidity for blended malt drink showed that malt drink are unfermented product and therefore non-alcoholic. The result is similar to that obtained by Akonor *et al.,* (2014) the values ranged from (0.07-0.20%). Titrable acidity acts as preservative and also impart taste.

The specific gravity of the malt drink samples ranged from (1.02-1.05). Sample A recorded the highest specific gravity value (1.05) while sample F recorded the lowest value (1.02). The specific gravity of liquid food is comparable to the weight of water. The specific gravity of all the malt samples indicate that malt drink are non-alcoholic, as they are unfermented. The result higher obtained in the study is higher than the one reported by Addel *et al.* (2017). It was found that the specific gravity of malt drink produced from sorghum were (1.012 and 1.045). The higher values obtained may be due to the amount of caramel added to malt samples.

The viscosity of malt drink samples varied from (1.21-2.67 mm^2/s). Malt from sample B recorded the highest viscosity value (2.67 mm^2/s) while sample E recorded the lowest value (1.21 mm^2/s). Sample A recorded a viscosity value close to the control samples. Viscosity determines the rheological flow property of the malt drink. Viscosity is important in the processing of food because it changes significantly during any process that involves heating, cooling, homogenizing and concentration Onwuka (2005).

The foam capacity of the samples ranged from (10-50). Sample are corded the highest percentage foam capacity value (50%) while, sample D having the lowest percentage foaming capacity (10%). However, sample A and E (50 and 40) have values as that of the control. Foam formation are influenced by malt source and the brewing method and it is one of the primary characteristics by which the consumer judge alcoholic and non-alcoholic drink quality Edyta and Natalia (2011).

Table 4: Physico-chemical analysis of malt drinks[1,2]

Samples	pH	% TS	%TSS	(%)TA	SG	Viscosity (mm^2/s)	%FC
A	4.97±0.03^c	16.6 ± 0.3^e	11.5± 0.1^{bc}	0.2± 0.01^d	1.05±0.05^a	1.33±0.09^a	50±5.0^d
B	4.55±0.18^b	11.84 ±1.04^c	9.5 ± 0.20^{abc}	0.19± 0.01^d	1.04±0.05^a	1.64±0.11^b	10±1.0^a
C	5.56±0.08^e	11.43± 0.59^c	10± 0.01^a	0.18 ± 0.02^{cd}	1.03±0.05^a	2.67±0.22^c	20±2.0^b
D	5.36± 0.08^{de}	9.17 ± 0.07^b	9 ± 0.02^{ab}	0.08 ± 0.02^a	1.05±0.04^a	1.74±0.20^b	10±2.0^a
E	4.34±0.04^a	7.04 ± 0.03^a	6.03 ± 0.057^a	0.14± 0.01^b	1.04±0.04^a	1.21±0.10^a	40±1.0^c
F	5.26±0.10^d	11.07± 0.02^c	9.07± 0.11^{ab}	0.16± 0.01^{bc}	1.02±0.01^a	1.57±0.01^c	20±1.0^b
G	5.28±0.10^d	15.14 ± 0.04^d	13.07± 0.11^c	0.16 ± 0.02^{bc}	1.07±0.02^a	1.38±0.10^a	60±3.0^e
H	5.4±0.20^{de}	15.26±0.05^d	13.1±0.10^c	0.14±0.01^b	1.05±0.01^a	1.40±0.001^a	40±2.5^c

[1]Means in the same column bearing different superscript are significantly different at$P<0.05$

[2]TS- Total solid, TSS- Total soluble solid, SG- Specific gravity, TA- Titrable Acidity, FM-Foam Capacity

a=SORMILL (70:30) SOR –sorghum; b=SORMILL (30:70) MILL-millet; c=SORMILL (50:50); d=MILLSOR (70:30); e=MILLSOR (30:70); f=MILLSOR (50:50); g=GOLDMALT

Vitamin C content of Malt drinks

The result of vitamin C content of malt drink samples is presented on Table 5. The vitamin C content ranged from (0.07 – 1.80 mg/100ml). Sample A recorded the highest vitamin C content (1.80 mg/100ml) while sample E recorded the lowest value (0.07 mg/100ml). The vitamin C content of the malt samples were found to be lower than that obtained for the controls. The low values obtained for the vitamin C content for the malt samples could be due to lack of fortification of the malt drink samples. Obuzor and Ajaezi (2010) reported values for some commercial malt ranged from (5.69-9.97 mg/dl).

Table 5: Vitamin C content of Malt drinks

Malt samples	Vitamin C (mg/100ml)
A	1.80±0.10^c
B	0.73 ± 0.04^c
C	0.95 ± 0.002^{bc}
D	1.07 ± 0.02^{ab}
E	0.07± 0.01^{bc}
F	0.73 ± 0.05^a
G	2.76± 0.10^c
H	3.66±0.20^c

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

Table 6: Microbial count analysis of Malt drinks

Malt samples	Microbial Count (cfu/ml)
A	0.35 ± 0.56^a
B	1.52±0.84^c
C	0.49± 0.78^a
D	1.32± 0.50^b
E	0.31±0.50^a
F	1.71± 1.11^c
G	0.34 ± 0.56^a
H	0.33±1.18^a

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

Microbial count analysis of Malt drinks

The results of bacterial count for malt drink samples are presented on Table 6. The results showed there were no significant difference at ($p\leq0.05$) observed in the total bacterial count of all the malt drink samples. The colony forming units (cfu/ml) of the malt drink samples ranged from (0.31-1.71 cfu/ml). Sample F recorded the highest colony forming (1.71 cfu/ml) while sample E recorded the lowest (0.31 cfu/ml). The microbial analysis is an indication of the level of contamination or commercial sterility of the malt drinks. The result showed that the malt drinks were found to be commercially stable and safe for consumption, since the values obtained for the bacterial count fell within the acceptable limit recommended by WHO (<100 cfu/ml).

Sensory evaluation of Malt samples

The results of sensory evaluation of the malt drink samples are presented on Table 7. The results showed that there was significant difference at ($p<0.05$) observed in all the parameters measured in the sensory evaluation of the malt drink samples.

Table 7: Sensory evaluation of Malt samples

Malt Samples	Color	Appearance	Taste	Flavor	Overall acceptability
A	6.6 ± 02^{e}	6.8 ± 0.1^{e}	5.6 ± 0.2^{e}	6.1 ± 0.0^{d}	6.9 ± 0.1^{d}
B	4.3 ± 0.1^{c}	4.5 ± 0.1^{c}	4.7 ± 0.2^{d}	5.1 ± 0.0^{c}	4.7 ± 0.2^{c}
C	3.4 ± 0.2^{b}	2.5 ± 0.1^{b}	4.0 ± 0.0^{c}	4.3 ± 0.1^{b}	4.3 ± 0.0^{c}
D	4.2 ± 0.0^{c}	4.2 ± 0.005^{c}	3.0 ± 0.0^{b}	3.5 ± 0.0^{a}	3.5 ± 1.0^{b}
E	5.6 ± 0.3^{d}	5.7 ± 0.05^{d}	4.1 ± 0.0^{c}	4.5 ± 0.1^{b}	4.4 ± 1.0^{c}
F	2.1 ± 0.0^{a}	2.1 ± 0.05^{a}	2.1 ± 0.0^{a}	3.5 ± 0.1^{a}	2.4 ± 1.0^{a}
G	6.5 ± 0.0^{e}	6.6 ± 0.1^{e}	5.5 ± 0.1^{e}	6.6 ± 0.3^{e}	6.5 ± 0.0^{d}
H	6.3 ± 0.2^{e}	6.5 ± 0.4^{e}	6.6 ± 0.2^{f}	6.6 ± 0.1^{e}	6.9 ± 0.0^{d}

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

The parameters (appearance, taste, flavor and overall acceptability) of the malt drink samples were observed to have significant difference at ($p<0.05$) from that of the controls. The controls had a superior mean scores for all the parameters measured compared to that of the malt samples. However, malt sample A was found to have mean score values close to the controls than other malt samples.

Conclusion

From the physicochemical, microbial and nutritional quality it showed that sample A (sorghum 70:30 millet) compared fairly with the commercial malt (control 1 and 2), produced exclusively from barley and sorghum. The study also showed that malt drink can be produce from the blends of sorghum and millet. Sample (A) if properly worked upon and subjected to industrial process will meet the consumer requirement of malt drink, and also the local sorghum and millet will substitute barley and be a good raw material to the brewing industries.

Recommendation

There is still need for further studies to improve the filtering techniques in the laboratory, the taste of the product and also there is the need to fortify the malt product with vitamins to meet the market standard.

Conflict of Interest

Authors have declared that there is no conflict of interest reported in this work.

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