ISSN : 0974 - 7435 Volume 7 Issue 1

Trade Science Inc.

BioTechnology
An Indian Journal

FULL PAPER

BTAIJ, 7(1), 2013 [11-15]

Optimization of malt drink production from acha and rice blends

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ABSTRACT

The optimization process for the production of malt from acha (*Digitaria exilis*) and rice (*Oryza sativa*) was studied following standard procedures. By varying the ratio of malted and unmalted acha and rice grains, four different malt drinks were produced comprising of 3:1 and 3:2 of malted and unmalted acha or rice. The proximate analysis showed that percentage crude protein levels were 8.08, 8.91, 9.74, and 8.91 for malt drinks rice (3:1; 3:2) and acha (3:1; 3:2) respectively, while ash (%) content were 0.12, 0.16, 0.18, and 0.20. Ether (%) extract values were 19.50, 17.5, 18.5, and 17.0 respectively. The result compare favorably with those of commercial maltina of 8.59, 15.5, and 0.25 of crude protein, total ether extract and ash content respectively. The result showed that sample rice (2:3) and acha (1:3) were stable up to week four whereas all others deteriorated from week one up to week four. Organoleptic score showed that the experimental malt drink compared well with commercial malt drink. Apparently, acha and rice may be good substitute to wheat or barley for the production of malt drink in Nigeria.

INTRODUCTION

The non-alcoholic malt drinks are additional products to bear which are produced and marketed by several breweries in Nigeria. Malt drink production involves the use of similar raw materials, machinery and procedure as in beer brewing[20]. There are more potential customers for the malt drinks than beer in view of its non-alcoholic nature[7].

Traditionally, barley malt has been used in the production of extract for making malt drinks. In recent times, there has been an increased utilization of locally grown cereals such as sorghum and maize as adjunct of barley malt in Nigerian breweries for the production of brewing extract[4]. This is in a bid to curtail the huge foreign exchange expended on the importation of barley used in the production of malt beverages.

Acha, (*Digitaria exilis*) or hungry rice is indigenous to West African where it occupies about 300,000 ha and provides food for about 4 million people[9]. In Nigeria, acha is popularly grown in five states (Bauchi, Kaduna, Kebbi, Plateau and Niger) and the Federal Capital Territory[2]. According to Kwon-Dung and Masari[9], acha is one of the world's best tasting cereals. It is one of the most nutritious of all grains and is the world's fastest maturing grain[12].

Traditionally, acha is used in preparation of unfermented porridge food and other dishes in Nigeria[14]. It is also used in dietary preparations for diabetic patients[22]. Acha could serve as a better alternative to barley (*Hordeum vulgare L.*) which is being presently used to produce conventional beverage (malt drink)[17].

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Rice (*Oryza sativa L.*) belongs to the family gramineae. Rice is the most popular food eaten world wide. It is consumed in the form of noodles, puffed rice, fermented sweet rice, and snack foods made by extrusion cooking. Rice can also be used as a source of cereal in infant food preparation[15]. It is considered most important stable food crop and whose potentials have not been fully tapped in Nigeria. Rice with a low starch gelatinization is preferred for rice puddings, breads and cakes and bear adjuncts; this allows starch gelatinization at lower processing temperatures, particularly in the presence of sucrose[8].

The present study therefore is designed to explore the possibility of acha and rice blends for the production of malt drinks.

MATERIALS AND METHODS

The samples of acha (*Digitaria exilis*) and rice (*Oryza sativa*) were obtained from National Cereal Research Institute (NCRI) Badeggi, Niger State, Nigeria.

Malta drink production

The malt drink was produced in the laboratory following the flow chart in Figure 1 below:

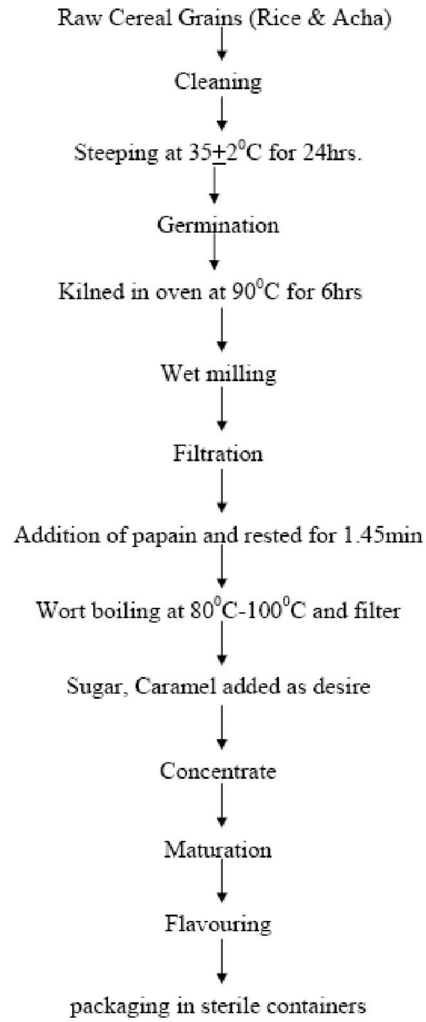

Figure 1 : Flowchart showing laboratory steps for optimal production of malt drink.

Cleaning

The grains were winnowed manually using tray and sieved to remove stone and silts.

Steeping

The grains (1kg each of acha and rice) were steeped in 2 litres of portable water each and left at room temperature of 35$\pm$2^{0}C. Subsequently, water was changed at six hour intervals for a period of 24 hours. The grains were then allowed to absorb water by Osmotic process and swell. Water was drained off from the steep using sieve and spread on a plastic tray, covered with jutesack for better aeration, and moistened regularly till germination occurs. Rice germination was terminated after 72hours (3days) and Acha after 96hours (4days), for maximum malting.

The germinated seedlings were kilned in oven at 90^{0}C for six hours to give sweet smelling and a pleasant aroma, and the rootlets removed manually.

Mashing

The germinated grains were crushed using laboratory blender into slurry and filtered using a muslin cloth to remove fibrous indigestible particles. Papain enzyme was then added for clarification and tested for 1hr 45min.

Wort boiling

Wort was heated to 80^{0}C to terminate all enzyme activity followed by another filtration process. The filtrate was boiled to about 100^{0}C to concentrate to sugary syrup. Caramel colour, little sugar and flavouring agents were added as desired.

The product was then bottled in sterile containers.

Organoleptic scoring

A 10-man panelist was organized to determine the organoleptic quality of the malt drink produced using a

7-point hedonic scale[6].

The four blend were prepared as shown in TABLE 1 below.

TABLE 1 : Production of malt drinks with different ratios of germinated and ungerminated rice and acha blends.

Samples	Cereal	Geminated	Ungerminated
A	Rice	25%	75%
B	Rice	40%	60%
C	Acha	25%	75%
D	Acha	40%	60%

The physiochemical properties of the drink such as pH, refractive index, titrable acid, ether extract, crude protein, carbohydrate and moisture content were determined using the AOAC[3], method.

RESULTS AND DISCUSSION

The organoleptic test conducted on the four blends revealed that sample A,B,A and D had the highest preference to the commercial malt drink as shown in TABLE 2 below.

TABLE 2 : Sensory assessment of different malt formulations using 7-point hedonic scale.*

Sample	Appearance	Mouth feel	Taste	Aroma	Overall acceptance
A	$2^a \pm 0.7$	$2^a \pm 0.9$	$2^a \pm 0.7$	$3^a \pm 0.9$	$2^a \pm 0.7$
B	$2^a \pm 1.2$	$3^a \pm 0.7$	$2^a \pm 0.6$	$3^c \pm 0.7$	$2^a \pm 0.6$
C	$2^a \pm 0.8$	$2^a \pm 1.0$	$2^a \pm 0.7$	$3^a \pm 0.8$	$2^a \pm 0.7$
D	$2^a \pm 0.7$	$2^a \pm 0.8$	$2^a \pm 0.7$	$3^{ab} \pm 0.9$	$2^a \pm 0.7$
Commercial malt drink	$2^a \pm 0.7$	$2^a \pm 0.8$	$2^a \pm 0.7$	$3^a \pm 0.7$	$2^a \pm 0.9$

Results are mean±SD of three replicates; *Values in the same column with different letter superscripts are significantly (p<0.05) different; 1.Values in the same column with different letter superscripts are significantly different (P<0.05); 2.Values were mean ± standard deviation from 10 values (respondents).

TABLE 3 : Proximate composition of different malt formulation.

Sample	Ether Extract%	Moisture Content%	Ash Content%	Crude Protein%	Carbohydrate %
A	19.5±1.2	76±1.0	0.12±0.5	8.08±0.26	72.30±0.5
B	17.5±1.09	76 ±1.0	0.16±0.25	8.91±0.9	73.40±0.6
C	18.5±1.5	80±1.5	0.18±0.5	9.02±0.5	71.58±0.5
D	17.0±1.2	80 ±1.9	0.20±0.7	8.91±0.8	74.85±0.9
Commercial malt	15.5±1.5	81±1.5	0.25±0.5	8.59±0.5	75.66±0.7

Values represent the meant of triplicate determinations ± SD for each sample.

From TABLE 2: the Duncan's multiple range test showed that there is no significant difference in the organoleptic scores of samples compared with the commercial malt. This implied that the appearances of samples are liked in similar way. Also there were no significant differences in the mean score of mouth feel between the samples, P>0.05. The mouth feel of all the samples were equally preferred. The taste of all samples were liked by the panelist as observed from the mean score which showed no significant difference at P>0.05. probability level.

For the aroma, there were significance in the mean score between the samples at P>0.05. Samples A,C,D, and the commercial malt were liked the same way while sample B had a low significance in the aroma. The formation was 40% germinated at 60% ungerminated rice which implies that the germinated cereal might have more impact on the aroma.

For the overall acceptability, there were no significant difference in the general acceptability among the samples at P>0.05 probability level.

TABLE 3: A close look at the table shows that the crude protein content value was within the same range with the commercial malt except for sample C with highest value of 9.02mg/g ± 0.5. This led credence to Victor and James[22], that the protein content of acha grains is higher, with more methionine and cysteine compared to other cereal. It requires adequate care since proteinous matter pose problem of forming gelatinous cloudy precipitate in beer and other similar products[16]. The proteins are known to be enclosed in the endosperm cells of the acha and rice raw materials. These proteins are broken down during malting by proteolytic enzymes[19]. In adults, the FAO/WHO/UNO safe intake of proteins has been reported to be 0.80g/kg for females and 0.85/kg for males[11]. Reducing sugars was found to abound in the malt drinks ranging from 71.58 ± 0.5 to 75.66 ± 0.7%/dl. This indicates that the malt drink produced from ash and rice blends may be a good sources of energy drink. Since they are rich in reducing sugars which are easily metabolized. The major sources of sugar in malt drinks is through the enzyme hydrolysis of the starchy raw materials during mashing[18]. Malting also contributes to decrease oligasacchandes (Stachyose and Raffinose) content by the grains[1]. Proteolytic enzymes

improve amino acid availability hence the variability observed in the pH and titrable acidity of the products[21]. Germination synthesizes flavor into the malt which leads to particular flavour given to the derived products[10]. No chemical preservative has been incooperated into the drink.

TABLE 4 : Changes in physiochemical properties of malt drink for 4 weeks.

weeks	O					1					2					3					4				
Parameter & samples	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
pH	5.8± 0.2	5.6± 0.2	5.6± 0.3	5.7± 0.2	5.0± 0.3	5.6± 0.2	5.6± 0.2	5.6± 0.2	5.7± 0.3	4.9± 0.1	4.7± 0.2	4.5± 0.2	4.7± 0.2	4.6± 0.3	4.5± 0.2	3.8± 0.1	3.6± 0.3	3.8± 0.1	3.7± 0.2	3.6± 0.2	4.1± 0.3	3.9± 0.3	4.1± 0.3	4.0± 0.2	3.8± 0.3
Refrac-tive index	1.350 ±0.1	1.376 ±0.2	1.363 ±0.2	1.365 ±0.2	1.375 ±0.3	1.373 ±0.3	1.361 ±0.2	1.367 ±0.2	1.375 ±0.3	1.352 ±0.1	1.360 ±0.2	1.354 ±0.1	1.350 ±0.1	1.360 ±0.2	1.337 ±0.2	1.362 ±0.2	1.358 ±0.2	1.352 ±0.1	1.363 ±0.2	1.340 ±0.2	1.367 ±0.2	1.361 ±0.2	1.358 ±0.2	1.365 ±0.2	1.344 ±0.2
Titratable Acidity	3.26 ±0.2	3.22 ±0.3	3.30 ±0.2	3.35 ±0.2	3.50 ±0.2	3.22 ±0.2	3.20 ±0.3	3.18 ±0.3	3.35 ±0.2	3.45 ±0.2	4.27 ±0.2	4.55 ±0.2	4.15 ±0.1	4.30 ±0.2	4.58 ±0.1	5.25 ±0.2	5.55 ±0.1	5.30 ±0.2	5.41 ±0.3	5.58 ±0.1	4.45 ±0.2	4.80 ±0.3	4.50 ±0.2	4.75 ±0.1	4.90 ±0.2

Values represent the mean of triplicate determinations ± SD for each sample.

CONCLUSION

The results from this study showed that malted cereal grains (Acha and Rice) have a very high brewery potentials, particularly for malt drinks and can serve as a better substitute to imported barley.

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