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The Use of Tiger-Nut (*Cyperus esculentus*), Cow Milk and Their Composite as Substrates for Yoghurt Production

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Abstract: Yoghurt was produced from skimmed cow milk and tiger nut milk. The pH of the yoghurt was found to increase with increasing tiger nut milk in the composite. From the comparison made of the sensory attributes of the three samples of yoghurt composite, the yoghurt produced from the combination of cow milk and tiger nut milk had the highest mean score in all the parameters even though the difference between the means of cow milk-tiger nut composite and that of pure cow milk was insignificant. Thus the result of the sensory evaluation revealed that yoghurt from pure cow milk and the composite (tiger nuts milk and cow milk) were rated alike in almost all the quality attributes indicating the feasibility of adding tiger nut to cow milk in the production of cheaper and nutritious yoghurt.

Key words: Tiger-nut, sensory evaluation, fermentation, starter culture

INTRODUCTION

Yoghurt is a fermented product produced by bacterial fermentation of milk from animal source. Fermentation of the milk sugar (lactose) produces lactic acid, which acts on milk protein to give yoghurt its texture and its characteristic tang (Moore, 2004).

Yoghurt has nutritional benefits beyond those of milk which people who are moderately lactose-intolerant can enjoy without ill effects due to the fact that the lactose in the milk precursor is converted to lactic acid by the bacteria culture. (Kolars, 1984; Ghanson, 2008). The reduction of lactose by passes the affected individual's need to process the milk sugar themselves.

Yoghurt is known to have medical uses in particular for a variety of gastrointestinal conditions and in preventing antibiotic-associated diarrhea. One study suggests that eating of yoghurt containing L-acidophilus helps prevent vulvovaginal candidiasis (Ringdahl, 2000).

Yoghurt can be presented in large variety. It can be presented as set or stirred (drinking) yoghurt, plain, partly skimmed or skimmed, sweetened and flavoured forms (Imele and Atemnkeng, 2001).

The increasing demand from consumers for diary products with functional properties is a key factor driving value sales growth in developed markets. This led to the promotion of added-value products such as probiotic and other functional yoghurts, reduced-fat and enriched milk products and fermented diary drinks and organic cheese (Rudrello, 2004). Another important global trend is the increasing demand for consumer convenience. Present day consumers prefer foods that promote good health and prevent disease (Khurana and Kanawjia, 2007).

Tiger-nuts (*Cyperus esculentus*) believed to be a tuber rather than a nut is a minor but important crop in Ghana, especially in the eastern region. In a survey conducted by the Council for Scientific and Industrial Research (CSIR) (1989) on the production and marketing of the crop at Aduamoa in the Kwahu South District of Ghana, it was observed that tiger-nuts production is predominantly the work of women, with 70% of farmers being women and 30% men. There are two distinct types being the Kwahu type with yellowish brown nuts and the Fanti type with a mixture of dark brown and black nuts. Customer preference for the Kwahu type is high.

The common name for the tiger-nuts in Ghana is 'ataadwe' as known in the Twi language. Tiger nuts have been cultivated for both human and livestock consumption. The tubers eaten raw or baked/roasted are about the size of eight peanuts and are abundantly produced in Ghana. (Ghanson, 2008) When eaten raw, they make a very acceptable snack and have a flavour and texture reminiscent of coconut. They can be rehydrated by soaking before consumption and even softened further by boiling. Tigernuts are rich in oil which can be extracted for culinary and industrial use (Mason, 2008).

According to Mason (2008), tiger-nuts has long been recognized for its health benefits as they are high in fibre, protein and natural sugars. They have a high content of soluble glucose and oleic acid, along with high energy content (starch, fats, sugars and proteins), they are rich minerals such as phosphorous and potassium and in vitamins E and C.

Tiger-nuts are believed to help prevent heart attacks, thrombosis and cancer especially of the colon. They are thought to be beneficial to diabetics and those seeking to reduce cholesterol or lose weight. The very high fibre content combined with its delicious taste make tiger-nuts ideal for healthy eating (Beniwal, 2004). These

numerous advantages and health benefits associated with tiger-nut makes it more attractive as an alternative source of milk in yoghurt production. Tiger-nut was also reported to have high content of oleic with positive effect on cholesterol level due to the high content of vitamin E. The nut was found to be ideal for children, older persons and sportsmen (Martinez, 2003). Therefore, tiger-nut, with its inherent nutritional and therapeutic advantage could serve as a good alternative to cow milk in the production of yoghurt. In addition, the inclusion of tiger-nut milk in the production of yoghurt could reduce the price of yoghurt and make it more affordable to many Ghanaians.

The aim of this study was to produce yoghurt with tiger-nuts, cow milk and their composite substrate and to conduct sensory evaluation to evaluate the general acceptance of tiger-nuts yoghurt.

MATERIALS AND METHODS

Extraction of Tiger-nuts milk: Fresh tiger-nuts were purchased from the Kotokuraba market in Cape Coast, Central region of Ghana. Preparation of the tiger nut milk was done by picking out those foreign and bad nuts that could affect the taste and keeping quality of the milk. The tiger-nut was washed and rinsed in distilled water. It was then soaked overnight to soften the fibre. 900 g of tiger- nuts were added to two litres of warm water and blended several times with a blender. The mash was then filtered through a muslin cloth to separate the milk from the mash. It was further strained to obtain a fine consistency.

The filtered tiger-nut milk was transferred into a container and pasteurized or heated at 90°C for 15 minutes and later cooled to a temperature of 43°C for 12 h. The filtrate was then poured into clean sterilized plastic containers for further processes.

Production of yoghurt from cow milk, tigernuts milk and composite: Skimmed milk of 0.8 kg was dissolved in two litres of water passed through heat treatment at 90°C for 15 min and later cooled to a temperature of 43 °C. One litre of cow milk was labelled Sample A, one litre of tiger-nuts milk was labelled Sample B whiles half a litre of the cow milk solution was added to half a litre of tiger nuts milk and labelled Sample C. The samples were all poured into adiabatic jars for fermentation. The initial pH was taken with a pH meter. The Samples at a temperature of 43°C were inoculated with 4% v/v starter culture and mixed thoroughly. The jars were afterwards covered and incubated at 42°C for 4 h to cause curdling and setting of the milk samples. After incubation, the jars were placed in a refrigerator to cool and final pH of each was taken. The Samples, A, B and C were stirred with a whisk and 150 g of sugar was added to each sample to taste.

Sensory analysis: Forty panellists of the Cape Coast Polytechnic comprising both male and female students were used in the sensory evaluation study. The panellists were selected based on their ability to discriminate and reproduce the results. All samples were served at temperatures of 10-15°C using plastic cups. The panellists were asked to compare the samples on the basis of appearance, sourness, consistency, aroma and general acceptance, using the hedonic descriptive scale 1-5. Water was available for panel members to rinse their mouths between samples. The tests were conducted in partitioned boots with fluorescent lighting.

From the data obtained, the mean values and standard error for each were calculated. The significance differences between the samples were tested using the F-test (one way analysis for variance). Analysis of variance was used for statistical treatment of the date ($p < 0.05$).

RESULTS AND DISCUSSION

The initial pH of the samples ranged between 5.52 and 6.40. Thus there was increase in pH values as the content of tiger-nut increased in the yoghurt. This result agrees with the results of Ade-Omowaye *et al.* (2008) for tiger nut-wheat composite flour and bread. The pH dropped to between 4.2 and 4.4 which agree quite well with the pH for the production of yoghurt (Imele and Atemnkeng, 2001). The pure tiger-nut yoghurt had the highest pH value while the pure cow milk yoghurt had the least.

The percentage and mean sensory scores for the yoghurt samples from the composite milk are presented in Tables 1 and 2, respectively.

Appearance: The appearance of the yoghurt refers to the level of visual appeal of the products obtained by fermenting the various milk substrates with relevant microbes. From Table 1, it is evident that based on the judgment of the panel, sample C which is made up of the composite (50 % tiger-nut milk and 50% cow milk) had the best visual appeal since altogether, 95% of the panel rated its appearance as good and very good as compared to 88 and 70% for samples A, which is cow milk only and B which is tiger-nuts milk only, respectively. This may be due to the synergistic effect the two substrates had on the general appearance which made it look better in terms of colour and smoothness. The means for samples A and C are not significantly different at the 1% level while they differ significantly with sample B.

Sourness: The sourness of the yoghurts expresses the level of astringency produced as a result of the production of lactic acid by the action of Lactobacillus lactic on lactose in the substrates. From Table 1, the

Table 1: Percentage score on comparative sensory evaluation of the tiger nut-cow milk yoghurt

	Sensory quality features				
Sample	Appearance	Sourness	Consistency	Aroma	General acceptance
A	88	98	98	98	90
B	70	75	88	90	64
C	95	95	98	100	92

Table 2: Organoleptic evaluation of tiger nut-cow milk yoghurt

	Sensory quality features				
Sample	Appearance	Sourness	Consistency	Aroma	General acceptance
A	3.7750	3.7250	4.0250	4.0000	4.4615
B	2.9750	3.1500	3.3000	3.4750	3.7949
C	4.1500	4.0250	4.2250	4.2250	4.5789

results on sourness for the three samples indicate that sample A was adjudged the best with 98% of the panellists assessing it as acceptable compared to 75% for sample B and 95% for sample B. The mean for sample C is a little higher that of sample A even though the difference is insignificant at the 1% level.

Consistency: The consistency is an attribute of the yoghurt to flow without forming lagging insoluble particles on the inner side of the containers. It refers to the property of the yoghurt to exhibit smoothness and good flow properties. From Table 1, it is observed that 98% of the panellists accepted the consistency of samples A and C. This means that the solubility of solids from the combined substrates must have improved upon fermentation as compared with sample A, which was milk only and sample B, tiger-nuts only. This result is subject to the effectiveness of homogenization of the various substrates after fermentation. The means for samples A and C are not significantly different.

Aroma: The aroma produced from the fermentation of the yoghurts is essentially due to the production of acetaldehyde and other volatile aromatic compounds resulting from the anaerobic breakdown of carbohydrates by the relevant microbes. It is seen from Table 1 that all the 40 panellists adjudged sample C as having the best aroma, followed by sample A and sample B. It is possible that a combination of these two substrates produces a wider scope of biomolecules that enables rather varied aromatic compounds. This could account for observed trend in the aroma of the products. The mean for sample C is a little higher than of sample A followed by that of sample B. The difference in the means between samples A and C are however insignificant while they differ significantly with sample B.

General acceptance: Generally, it could be deduced from the results that sample C is preferred to samples A and B, even though sample A is more acceptable than sample B. The impression is that consumers are more inclined to accept yoghurt made from two-composite substrate than one substrate. The p-value ($p<0.05$) obtained from the one-way analysis of variance indicates that the difference between the means for samples was insignificant.

Conclusion: From the comparison made of the sensory attributes of the three samples of yoghurt composite, based on the parameters, appearance, sourness, aroma, consistency and general appearance, sample C had the highest mean score in all the parameters followed by sample A and then sample B. This clearly shows that sample C which was yoghurt made from composite of tiger-nuts milk and cow milk was the most preferred by consumers. Sample A made from cow milk only was also preferred over sample B. Thus the result of the sensory evaluation revealed that yoghurt from pure cow milk and the composite (tiger-nuts milk and cow milk) were rated alike in almost all the quality attributes indicating the feasibility of adding tiger-nut to cow milk in the production of cheaper and nutritious yoghurt.

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