Preliminary study on the influence of moringa seed extracts supplementation on the yield and quality of cottage cheese

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Short communication

Abstract: Variability of quality of product makes cottage cheese production unattractive to urban populations. Meanwhile demand for value-added dairy products is on the increase in the urban areas. This study investigated the effect of moringa seed extract (0.5%, 1%, 1.5% and 2%) supplementation on the yield and quality of cottage cheese prepared from fresh cow milk coagulated with latex from *Callotropis procera*. Yield, milk coagulation time, pH, moisture content, percentage protein, percentage fat, phosphorous and ash content of cottage cheese were determined. The pH of cottage cheese increased with increase in moringa seed extract. The control sample gave a pH of 6.52, whiles 0.5%, 1%, 1.5% and 2% concentrations of moringa seed extract gave pH values of 6.54, 6.55, 6.56 and 6.62 respectively and their difference were significant ($p<0.05$). Yield of cottage cheese also increased significantly ($p<0.05$) with increase in concentration of moringa seed extract**.** The 500mls of milk yielded 18.19% cheese in the case of the control whereas 0.5% moringa seed extract yielded 19.75%. Also, 1%, 1.5% and 2% concentrations of moringa seed extract gave outputs of 22.55%, 23.66% and 24.42% cheese respectively. Protein content of cheese increased from 14.50± 0.00% to 14.96 ± 0.00% when 0.5% moringa seed extract was added, to 16.01 ± 0.00% after the addition of 1% moringa seed extract, to 18.31 ± 0.00% when 1.5% moringa seed extract was added and to 18.50± 0.00 following an addition of 2.0% moringa seed extract. The differences were statistically significant ($p<0.05$). This study also revealed that phosphorous content, ash content and fat of cheese all increased significantly ($p<0.05$) with increase in moringa seed extract concentration. Effect of moringa seed extract on moisture content was however not clear. Moringa seed extract enrichment resulted in significant increases in the yield, protein content and mineral content of cottage cheese and therefore has the potential to be used in improving the yield and quality of cottage cheese

Key words; Cottage cheese, yield, quality, supplementation, moringa seed

Introduction:

Cottage cheese extends the shelf life of milk by preserving the valuable nutrients in milk for a longer period thereby guaranteeing regular protein supply throughout the year. Additionally, the low lactose content of cottage cheese makes it an acceptable food to many African and Asian populations who suffer from lactose intolerance associated with milk consumption[1]. Cottage cheese production thrives mainly in the peri-urban milk producing areas where it provides employment mainly to women and increases the incomes of fresh cow milk sellers. A higher demand for traditional soft cheese (*wagashi*) increased incomes of milk sellers by 54% in Ghana [2] . Generally, cottage cheese is produced in Ghana by small holder groups in the rural and peri-urban communities mainly from cow milk under "indigenous" conditions using skills based on traditions. Latex from the Dead Sea Apple shrub (*Calotropis procera*) which contains the enzyme, calotropin is used as milk coagulant[3].

High, non-specific proteolytic activity of vegetable rennets in general have been noted [4] to affect the yield during traditional cheese making and also lead to generation of excessive acid, bitter flavors as well as texture defects [5]. Evidence indicates that it takes about 5 litres of fresh cow milk to produce only one kilogram of cheese [6,7]. Quality of cottage cheese varies on

the market due to lack of standard manufacturing procedures to an extent that its variability is observed to account for the low acceptability of cottage cheese particularly in urban areas [8,9, 10, 11] .

To make cottage cheese production more profitable to producers and more acceptable to the urban communities, there is therefore the need to address the issues of yield and quality. Furthermore, demand for value-added dairy products is increasing due to increased urbanization, growth in incomes in the developing countries, growing power of supermarkets and changes in eating habits [12].

Moringa oleifera is an important nutritional supplement with high concentrations of proteins, vitamins, minerals and a variety of medicinal properties some of which include: antimicrobial effect [13], antioxidant effects [14], hypoglycemic activity [15], radioprotective effects [16] , regulation of thyroid hormone [17] and hypo cholesterol activity. For example, Moringa leaves are said to contain more Vitamin A than carrots [18] , more calcium than milk, more iron than spinach, more Vitamin C than oranges, and more potassium than bananas, and that the protein quality of Moringa leaves rivals that of milk and eggs [19] . More importantly, the dried seed extract contains natural coagulants which have been used in several industries. For example, the seed extract is used as a non-toxic natural polypeptide for sedimenting mineral particles and organics in the purification of drinking water, for cleaning vegetable oil, or for sedimenting fibers in the juice and beer industries [20].

To date, to the best of our knowledge, literature on the use of moringa seed extract in the production of value-added cottage cheese is not readily available. The objective of the study was to investigate the effect of supplemented moringa seed extract on the yield and quality of cottage cheese.

Materials and methods:

Preparation of moringa seed extract

Mature *Moringa oleifera* seed pods were collected from the crop division of the ministry of agriculture and seeds removed from pods. Seed coats were removed from seeds to obtain clean seed kernels and discolored seeds were discarded. About 8g of seed was weighed aseptically on an analytical balance and crushed with a sterile mortar and pestle to obtain a fine powder. The powder was then poured aseptically into a 250 ml screw-cupped bottle containing 100 ml sterile distilled water and vortexed to mix.

Collection of latex from *Callotropis procera*

Latex was collected from plants growing on the compound of the Ghana Atomic Energy Commission at Kwabenya in Accra, Ghana. The base of leaves of *Callotropis procera* was cleaned with alcohol and allowed to dry, the leaves were then broken and free-flowing latex collected into a sterile screw-cupped bottle and sent to the laboratory for immediate use.

Procurement and pasteurization of cow milk

Fresh cow milk samples were purchased on days of experiment into sterilized 5litre containers from cattle farms at Kwabenya, a suburb of Accra, Ghana and transported immediately to the laboratory under cold storage. In the laboratory the milk was pasteurized in a water bath at 65^0C for 30 minutes

Cheese making (coagulation of milk)

This was done on a hot plate magnetic stirrer. About 500 ml of pasteurized milk was each heated in 1-liter beakers whiles stirring on the hot plate. Latex was dropped into each beaker when the temperature was 65^oC after which moringa seed extract was immediately added to the milk using a different sterile pipette for each preparation and allowed to curdle. Cheese production was carried out generally, following methods described by [1]with modifications regarding pressing of cheese. After the milk was fully coagulated, the whey-coagulum mixture was poured into a cheese basket containing a cheese cloth and sited in an aluminum box to collect the whey. The setup was left for the whey to filter through till it stopped dripping. The cloth was folded with the coagulum in it, pressed to let out the remaining whey, tied and pressed with a known weight to dry to a constant weight (approximately after 2hrs). The cheese was then removed into a sterile container and stored in the fridge at 4^oC overnight or analyzed immediately. Table 1 show various treatments carried out.

Table 1: Treatments carried out

Sample ID	A	B	C	D	E
Volume of milk and latex used	500 ml milk + 2 ml latex	500 ml milk + 2 ml latex	500 ml milk + 2 ml latex	500 ml milk + 2 ml latex	500 ml milk + 2 ml latex
Volume of moringa extract used	0 ml	0.5 ml	1.0 ml	1.5 ml	2.0 ml

Parameters determined:

Yield, pH, moisture content, ash content, crude protein, phosphorous and fat content. The cheese yield was determined per treatment by weighing the amount of coagulum obtained and expressing as a percentage. Moisture content, pH, ash content, crude protein, phosphorous and fat content of cheese samples were determined in triplicates following methods described by [21] .

Data analysis:

Data was subjected to ANOVA using Minitab Release 14 statistical software (Minitab Inc., USA). Significant differences were determined at $p < 0.05$ and means separated using Fisher $LSD_{0.05}$.

Results and Discussions:

Results of the influence of varying concentrations of moringa seed extract on yield and some nutritional properties of traditional soft cheese (Waghazi) coagulated with latex from *Calotropis procera* are summarized in Table 2.

Table 2. Yield and chemical composition of Waghazi cheese supplemented with moringa seed extract.

Sample ID	pH	Moisture (%	Ash (%)*	Protein (%)*	Fat (%)*	Phosphorus (mg/100g)*	Yield (%)	Coagulation time (mins)
A	6.52 ^{e} ± 0.02	68.49 ^{a} ± 0.01	0.87 ^{d} ± 0.00	14.50 ^{e} ± 0.00	28.15 ^{e} ± 0.01	0.173 ^{e} ± 0.000	18.19 ^{e} ± 0.50	2.58 ^{a} ±0.01
B	6.54 ^{d} ± 0.01	64.26 ^{d} ± 0.02	0.89 ^{c} ± 0.00	14.96 ^{d} ± 0.00	31.79 ^{d} ± 0.01	0.178 ^{d} ± 0.000	19.75 ^{d} ± 0.68	3.00 ^{a} ±0.00
C	6.55 ^{c} ± 0.00	66.54 ^{b} ± 0.04	0.89 ^{c} ± 0.00	16.01 ^{c} ± 0.00	32.35 ^{c} ± 0.01	0.180 ^{c} ± 0.000	22.55 ^{c} ± 0.55	3.01 ^{a} ±0.00
D	6.56 ^{b} ± 0.01	66.68 ^{b} ± 0.02	0.93 ^{b} ± 0.00	18.31 ^{b} ± 0.00	33.22 ^{b} ± 0.01	0.184 ^{b} ± 0.000	23.66 ^{b} ± 0.12	3.00 ^{a} ±0.01
E	6.62 ^{a} ± 0.01	64.22 ^{c} ± 0.02	0.94 ^{a} ± 0.01	18.50 ^{a} ± 0.00	34.04 ^{a} ± 0.00	0.196 ^{a} ± 0.000	24.42 ^{a} ± 0.25	2.59 ^{a} ±0.00

N=3 a-e: Values with different letters in column are significantly different from each other at $p < 0.05$
Values are means ±standard deviation * Values are calculated on dry matter basis

The results (Table 2) suggest that the addition of moringa seed extract to milk and latex increased the pH of the mixture and cheese produced from it. For example whereas the average pH of the control sample (A) was 6.52, 0.5%, 1%, 1.5% and 2% concentrations of moringa seed extract gave pH values of 6.54, 6.55, 6.56 and 6.62 respectively (Table 2). These observed differences in pH values were statistically significant ($p < 0.05$). The major factor inducing acidity in soft cheese is lactic acid production [22] .

The moringa seed extract may have suppressed the growth of lactic acid producing micro-organisms resulting in the reduction of the amount of acid produced from the fermentation of lactose. Cheeses have a tendency to remain soft at higher pH values; additionally acidity helps extend the shelf life of cheese [23] so there may be the need to keep the pH values in this study lower. It is recommend that the use of citric acid in the rinse water, along with the

addition of five parts per/ million chlorine to the water to lower the pH in cheese production [24].
Moisture content results of the control sample (A) obtained in this study (Table 2) was comparable to values obtained for soft cheese by [1], [25] .The use of different inputs and lack of standard production procedures accounts for variations in nutritional components of cheeses in developing countries [1, 26]. The influence of moringa seed extract on the moisture content of cheese did not however follow any clear pattern (Table 2). This may have been as a result of the lack of a standard pressing and draining process. High moisture content is very important for microbial growth and the shelf life of cheese, internationally, moisture content of up to 80% is accepted for cottage cheeses [27].

The results in Table 2 showed that the yield of cheese increased with an increase in concentration of moringa seed extract. For example, whereas 500mls of milk yielded 18.19% cheese in the case of the control sample (A) the same volume of milk when supplemented with 0.5% moringa seed extract yielded 19.75% cheese and 1%, 1.5% and 2% concentrations of moringa seed extract gave outputs of 22.55%, 23.66% and 24.42% cheese respectively (Table 2). The differences in cheese output were statistically significant ($p < 0.05$). Clearly, this suggested that moringa seed may have accounted for the increase in yield. Moringa seed is known to contain high concentrations of proteins and fat both of which play a role in the yield of cheese [20]. Cheese output is directly related to the amount of milk solids in the milk and more specifically, to the amount of protein [28]. This is because cheese product is formed mainly by the coagulation of proteins in milk, thus the greater protein content the greater the yield of cheese product [29].

Protein, fat, ash and phosphorous contents of cheese all increased directly with increases in moringa seed extract concentrations in cheese. The high concentration of these nutrients in moringa seed may have accounted for the observed increase in protein, fat, ash and phosphorous contents in Table 2. Protein content of cheese increased from 14.50± 0.00% to 14.96 ± 0.00% when 0.5% moringa seed extract was added, to 16.01 ± 0.00% after the addition of 1% moringa seed extract, to 18.31 ± 0.00% when 1.5% moringa seed extract was added and to 18.50± 0.00 following an addition of 2.0% moringa seed extract (Table 2). Difference in protein concentration observed as a result of addition of different concentrations of moringa seed extract was statistically significant ($p < 0.05$).

An increase in fat content of cheese observed in this study may not be all that desirable even though evidence [30, 31] indicate that high fat content in milk also impacts positively on the yield of cheese. This is because of the concerns of high cholesterol diets and their implications on health. There is therefore the need to reduce the fat content of moringa seed before adding it to milk and this can be achieved by using the press cake obtained as a by-product of the oil extraction process. Evidence indicates that the press cake still contains a very high level of protein [20].

This study (Table 2) also revealed that phosphorous content and ash content of cheese increased with increase in moringa seed extract concentration. Values of moringa enriched samples were significantly different ($p < 0.05$) in terms of phosphorous and ash content from control samples. High ash content is generally linked to high mineral content of samples [32]. This observation suggests that moringa enrichment may have generally increased the mineral content of cheese. Moringa seed enrichment of cheese did not however, change the coagulation time of milk as indicated in Table 2.

In conclusion, moringa seed extract enrichment resulted in significant increases in the yield, protein content and mineral content of cottage cheese and therefore has the potential to be used in improving the yield and quality of cottage cheese. Further research is however required to buttress these findings.

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