Physicochemical Properties of Curd Prepared from Melon Seeds

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Abstract

Melon seed was investigated as an alternative to soybeans for production of high protein curd. The coagulating properties of calcium sulphate and the nature of the curd obtained from melon seeds were investigated. The yield, proximate composition and sensory properties of the melon curd were determined. The yield of curd from melon seed at 0.54% calcium sulphate concentration was 21% with the protein yield of 33%. Among the concentrations of calcium sulphate studied, 0.54% appeared to be most suitable for making curd of smooth texture. In general, scores for all the sensory attributes evaluated increased with increased calcium sulphate concentration. The melon curd was highly rated and very well accepted.

Keywords: Melon curd, coagulation, protein, calcium sulphate, acceptability.

Introduction

Melons (*Colocynthis citrullus L*) are widely grown in Nigeria for their seeds which are rich in protein and oil (Akobundu *et al.*, 1982, Onuora and King, 1983; Akubor, 1998). The seed is an important condiment in traditional soups and stews. The seed is also moulded into balls, fried and eaten as snacks or fermented to produce "ogiri," a condiment.

In recent years, soybean curd has received considerable attention. A good review on the manufacturing of soybean curd had been presented (Shurtleff and Aoyagi, 1984). Saio (1979) reported that higher solids in soymilk correlated with harder soybean curd and increasing agitating temperature with increased hardness of soybean curd. Wang and Hesseltine (1982) investigated some of the coagulating conditions in soybean curd processing and reported that to obtain a good curd, the concentration required for commonly used salts was in the range of 0.01 to 0.1M. Selection and addition of a coagulant at the proper concentration is important in determining the texture of soybean curd. In similar investigations, field peas (Gebre-egziabher and Summer, 1983), winged bean (Srikantha *et al.*, 1983), chickpea, mungbean, peanut and cowpea (Mohammed *et al.*, 1989), have been evaluated for their curd qualities. On the other hand, other seeds such as melon have received little attention.

It is thought that melon seeds could be processed into a curd, in the same way soybeans are used in oriental diets (Beuchat, 1984, Wang, 1984). Melon curd has the potential as a high protein low-cholesterol base for vegetarian foods such as legume sausages, spreads, burgers, cheese etc. It is expected that the melon curd would improve the protein supply and alleviate some of the nutritional problems caused by inadequate protein intake in Nigeria.

The objectives of this study were to prepare curd from melon seeds and to get more detailed information on the coagulating properties of calcium sulphate. The melon curd samples were compared with soybean curd.

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Materials and methods

Materials

Melon seeds were purchased from a local market in Idah township, Nigeria. The seeds were stored in jute bag until used. Unless stated otherwise, all chemicals used were of analytical grade.

Methods

Melon milk

The melon seeds were dehulled manually and the hulls winnowed off. The kernels were milled (No. 1A premier Mill RLA 201-80014) and sieved through a 40-mesh sieve (British Standard). Thereafter, the flour was defatted in a Soxhlet apparatus for 10-12h using petroleum spirit (b.p 40-60° C) and then oven dried (105° C, 1 h) to desolventize the flour. In a preliminary experiment a 1:4 flour to water ratio was found optimum for the preparation of the curd. This condition was used to evaluate melon curd in subsequent studies. The melon kernels were blanched with 4 volumes of water in a Kenwood blender operated at full speed for 10 minutes. The slurry was screened through a double folded cheese cloth to obtain the milk extract.

Melon curd

The melon milk was boiled at (95° C for 15min) with continuous stirring in a water bath, cooled to 70° C and then divided into 25ml portion in 50ml centrifuge tubes. A 2ml portions of calcium sulphate pre-incubated at 70° C was added slowly into the milk (pH 6.0) while the tubes were rotated gently (Srikantha *et al.*, 1983. The tubes were incubated at 70° C for 10 minutes. During the trial experiment calcium sulphate concentrations 0.54, 0.40, 0.27 and 0.15% were evaluated. Other incubation temperatures evaluated were 60, 80, and 90° C. However, appreciable curd was not formed at such temperatures. Thereafter, the milk was centrifuged (Hettich Universa II, Germany) at 200 rpm for 30 minutes. The supernatant was discarded and the curd was scrubbed from the tubes onto a 40- mesh lined with double folded cheese cloth. A circular plywood disc was placed on top of the curd and pressed with a 300g weight for 1-2 h. The curd yield was expressed as fresh weight of curd prepared from 100ml melon milk.

Soybean curd

Fifty gram dry whole soybeans were washed in tap water and soaked in enough volume of tap water at ambient temperature overnight. Thereafter, the water was discarded and the hydrated seeds were blended with water (1:10, seed: water) in a Kenwood blender operated at full speed for 10 min. The curd was then precipitated, separated and drained using the procedure previously described for melon curd.

Frying of curds

Pieces of 3.0cm x 1.0cm x 1 cm were cut from fresh melon and soybean curd blocks, respectively. The pieces were deep fried in groundnut oil (160° C, 5 min). The fried curds were cooled to ambient temperature (30 ± 2° C), heat sealed in 50g quantity in high-density polyethylene bags (0.70mm thickness) and stored in a refrigerator at 10° C.

Chemical analyses

Fresh and fried curd pieces, respectively were crushed and mixed well to obtain a representative sample. Moisture was determined by hot air oven drying at 105°C to constant weight. Ash, protein (Micro-Kjeldahil method, N x 6.25), crude fiber and fat (Solvent extraction) were determined by the AOAC (1984) methods 14.085, 14.086, 14.087, 14.089, respectively. Total solids were calculated as 100-moisture content (%). All determinations were made in triplicate and mean values reported.

Sensory evaluation

Samples of fried melon curd along with soybean curd were evaluated by untrained panel of twenty judges for colour, flavour, taste, texture and overall acceptability. The samples were evaluated on a 5 – point scale (1= very poor, 3, good, 5= extremely good).

Data analyses

Data were subjected to analysis of variance (Steel and Torrie, 1980). The means where significant were separated by least significant difference test. Significance of mean differences were accepted at P= 0.05.

Results and discussion

Chemical composition

The chemical composition of melon milk, fresh and fried melon curds are presented in Table 1. The curd samples contained high amounts of protein when compared with that of melon milk from where they were prepared. Fat contents varied among the melon milk and the curd samples, values being substantially higher ($P < 0.05$) for the fried curd. The high ash content in the melon curd resulted from calcium sulphate used for the precipitation. Soybean curd prepared in this way is considered to be a good source of calcium in countries where milk supply is low or expensive (Gebre-egziabher and Summer, 1983). The moisture content of the fresh melon curd was 70%. Although there is no recognized standard of identity for soybean curd. generally commercially available hard soybean curd contains from 75 – 79% moisture while the water content of soft soybean curd ranges from 82 – 88% (Shurtleff and Aoyagi, 1984). Moisture contents of 84.7% and 85.9% for soybean curds reported by Tsai *et al.*, (1981) were higher than that of melon curd moisture.

Table 1: Chemical composition of Melon Seed Milk (MSM) Raw Melon Curd RMC) and Fried Melon Curd (FMC)

Composition (%)	MSM	RMC	FMC7	LSD 0.05
Crude Protein	6.0 ± 0.4^b	19.0 ± 0.1^a	3.3 ± 0.1^a	5.0
Crude Fat	2.0 ± 0.8^b	1.5 ± 0.2^b	19 ± 0.3^a	2.0
Crude Fiber	0.5 ± 0.9^a	1.0 ± 0.4^a	1.5 ± 0.4^a	1.5
Ash	0.5 ± 0.1^c	4.0 ± 0.9^b	6.5 ± 0.1^a	1.8
Moisture	89.0 ± 2^a	7.0 ± 0.3^b	10 ± 0.2^c	2.0
Carbohydrate	2.0 ± 0.5^b	4.5 ± 0.2^a	3.0 ± 0.5^{ab}	2.0
Total solids	11.0 ± 0.1^c	30 ± 0.6^b	90 ± 0.8^a	8.0

Means ± SD of 3 determinations. A, b, c, means within a row with the same superscript were not significantly different ($P \geq 0.05$). Means were separated by the least significant difference (LSD) test.

The composition of soymilk varied with the amount of water used for the extraction (Wang and Hesseltine,1982). The Kernel/water ratios 1:2, 1:4, 1:5, 1:7, 1:8 and 1:10 were experimented in this study. Of these ratios, the 1:4 produced the curd of preferable consistency. Too little water resulted in incomplete extraction, while too much water resulted in aqueous extracts which were dilute. For soybean curd, Wang (1984) reported a ratio of 1:8 to 1:10. But for winged bean curd, a ratio of 1:3 was found to be most suitable (Srikantha *et al.*, 1983). It appears, therefore, that different bean types would require different ratios for this kind of work.

Of the incubation temperatures 60, 70 and 90° C tested for the production of melon curd, the curd produced at 70° C had a semi-solid consistency. This falls within the range of 60-80°C reported for the production of winged bean curd (Srikantha *et al.*, 1983) and peaflour curd (Gebre-egziabher and Summer. 1983). The heat treatment was used to improve the formation of the curd and to reduce the beany flavour of the melon milk. Heating causes the native protein to unfold, exposing anionic groups to cross-link with divalent cations and sulphydryl groups to form disulphides (Wang and Hesseltine, 1982). In dilute solution, the unfolded proteins remain soluble, but as the exposed groups are brought closer together through concentration or neutralization of molecular charges, irreversible aggregates result (Wang and Hesseltine, 1982). The melon milk has to be boiled up to 70°C to cause unfolding, but below 90°C, to optimize the interactions. Low temperatures yielded paste like gels and excessive heat decreased cohesion. This was probably caused by an increase in the number of accessible sulphydryly groups to a maximum, but then decreased due to oxidation. The optimum heating time was found to be 10 minutes.

Influence of calcium sulphate concentration

The relationship between the concentration of calcium sulphate used and the characteristics of the resulting melon curd is shown in Table 2. The moisture content of the curd decreased with increasing concentration of the coagulant. With increase in calcium sulphate concentration, the structure of the curd became porous, separating more whey and leaving less moisture in the curd.

Table 2: Effect of Calcium Sulphate ($CaSO_4$) concentration on Melon Curd Properties

$CaSO_4$ Conc (%)	Moisture (%)	Protein Yield (%)	Curd Yield(%)
0.15	80[a]	17.0[d]	11.0[d]
0.27	74[b]	20.0[c]	14.0[c]
0.40	72[c]	27.1[b]	18.0[b]
0.54	70[d]	33.0[a]	21.0[a]
LSD 0.05	1.0	0.9	1.8

a,b,c, means within a column with the same superscript were not significantly different (P≥0.05. Means were separated by the least significant difference

The yield of the curd from melon seed at 0.54% calcium sulphate concentration was 21% with protein yield of 33%. Wang and Hesseltine (1982) in their study of soybeans obtained a curd yield of 31.7%. The lower curd yield for melon seed was due to lower protein content and also to the large amount of carbohydrate residue removed during the curd preparation. The protein content of the melon curd and the curd yield increased as the concentration of the calcium sulphate increased over the range investigated. The lower yield and the turbid filtrate that appeared when 0.15% calcium sulphate was used, indicated incomplete coagulation of the protein. The optimum concentration of coagulant (0.54%) obtained in this study was similar to the range of concentration (0.40-0.54%) used for pea curd (Gebre -egziabher and Summer, 1983). Excess coagulant yielded hard curd. Since the problem with non-soybean curds is their lack of firmness, excess coagulant would be desirable. The only drawback is that excess calcium sulphate gives a bitter after taste.

Sensory properties

The influence of calcium sulphate concentration on the sensory quality factors of melon seed curd is presented in Table3. In general, the sensory scores for all the attributes evaluated increased with increased concentration of calcium sulphate. The curds prepared with high levels of calcium sulphate (above 0.27%) were firmer than those at lower concentrations. At 0.54% calcium sulphate, the curd obtained was smooth and uniform. Firmness also improved the taste of the curds.

Table 3: The effect of Calcium Sulphate ($CaSO_4$) concentration on Sensory properties of melon curd

Sensory properties	0.15	0.27	$CaSO_4$ Conc (%) 0.40	0.54	Lsd 0.05
Appearance	1.2^{b}	2.5^{b}	2.8^{ab}	4.0^{a}	1.2
Flavour	1.4^{b}	2.7^{b}	3.0^{b}	4.2^{a}	1.0
Taste	2.9^{a}	3.3^{b}	3.7^{a}	3.9^{a}	1.5
Texture	3.3^{b}	3.5^{a}	4.1^{ab}	4.4^{a}	0.8
Colour	3.1^{b}	3.5^{ab}	3.9^{ab}	4.1^{a}	0.9
Overall Acceptability	1.5^{c}	2.8^{bc}	3.1^{b}	4.3^{a}	1.0

a,b,c, means within a row with same superscripts were not significantly different ($P \geq 0.05$). Means were separated by least significant difference (LSD) test. Samples were evaluated on a 5 - point scale

Sensory evaluations of fried curd samples from melon and soybean seeds are summarized in Table 4. In general, judgements for the sensory properties of all samples ranged from a mean of about 3 (good) to 4 (very good). The panelists did not detect any significant difference ($P > 0.05$) in appearance, texture, colour and overall acceptability among the melon and soybean curd samples.

Table 4: Mean sensory scores of melon and soybean urds

Sensory properties	Melon Curd	Soybean curd	LSD 0.05
Appearance	4.0^{a}	4.3^{a}	0.5
Flovaur	3.2^{b}	4.3^{a}	0.8
Taste	3.0^{b}	4.2^{a}	1.0
Texture	4.4^{a}	4.6^{a}	0.9
Colour	4.1^{a}	4.4^{a}	0.4
Overall Acceptability	4.3^{a}	4.6^{a}	0.5

a,b,means with a row with the same superscript were not significant difference ($P \geq 0.05$). Means were separated by the least significant difference (LSD) test. Curds were evaluated on a 5- point scale (1=very poor, 3 = Good, 5 = Extremely good).

The melon curd was highly rated and very well accepted.

Conclusion

The study has shown that melon seed possessed the potential for production of curd. The results could be important in providing an alternative method of utilizing the melon seed. However, many factors affect the final curd product. Knowing the effects each factor produces, a set of conditions to reproduce a desired type of melon curd could be established.

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