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Quality Characteristics and Consumer Acceptance of a Peanut-Based Imitation Cheese Spread

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ABSTRACT

Six formulations of an imitation cheese spread were prepared by mixing cheese flavoring coloring, salt and buttermilk powder into a bland light colored peanut paste Three levels of flavoring (4, 6, and 8%) and two levels of salt (0 5 and 1 0%) were used Hedonic responses of 200 Filipino consumers to the formulations were obtained Results indicated that of the six formulations two (4% flavoring/1% salt and 6% flavoring/0 5% salt) were preferred Compositional analysis, instrumental texture and color of the formulations and three commercial cheese spreads were determined Compared to commercial cheese spreads, the peanut based samples had higher protein and oil contents and lower moisture indicating a more nutritious potentially shelf stable product

INTRODUCTION

IN DEVELOPING COUNTRIES where dairy products are expensive and insufficient in quantity, dairy substitutes prepared from legumes provide a nutritious alternative Soybeans have traditionally been used in the preparation of soybean cheese or 'sufu' (Smith, 1949) Lactic acid fermentation was found to produce cheese with the firmest texture (Hang and Jackson, 1967a), while the addition of skim milk and rennet to the soymilk was found to reduce coagulation time in the manufacture of the cheese (Hang and Jackson, 1967b) As much as 20% soymilk has been used as partial replacement for cow's milk in 'domiati', an Egyptian soft cheese (Metwalli et al , 1982), and in 'waranakasi', a similar product in Nigeria (Aworh et al , 1987)

Cheese like products from peanut milk have had limited success mainly because milk-like extracts from legumes do not produce a coagulum firm enough for making hard-type cheese Studies using ficin (Krishnaswamy and Johar, 1960), acetic acid, calcium sulfate and glucono lactone (Krishnaswamy and Patel, 1968) to coagulate peanut milk have been conducted However, when aged the curds produced did not ripen into acceptable products

Curds made from peanut milk were used in the preparation of a processed cheese like spread (Guirguis et al , 1985) Cheese analogs produced from a blend of peanut protein isolate, calcium/sodium caseinate, oil, emulsifiers and water had a consistency varying from firm-type cheese to cream cheese and spread type products depending on the amount of peanut isolate used (Chen et al , 1979) Upchurch (1978) developed a cheese spread composed of up to 50% peanuts Variations in the amount and type of emulsifier used resulted in products that ranged from firm to soft spread Sensory analysis conducted on a product prepared by adding cheese flavor and annatto extract to peanut paste indicated that the product may have potential as a cheese substitute in developing countries (Santos et al , 1987)

Methods for processing peanut kernels for production of a low moisture, light colored, bland flavored peanut paste have been studied (Santos, 1987) The use of such a paste as the basic ingredient in the manufacture of an imitation cheese spread presents several advantages First, the paste, which contains about 25% protein and 45% oil, would make an ideal food supplement in parts of the world where protein calorie malnutrition is prevalent Second, the use of locally grown peanuts would make the product less expensive to produce than cheese substitutes made from imported dairy ingredients Lastly, the low moisture content contributes shelf stability to the product, an important consideration in countries like the Philippines, where refrigeration is uncommon not widely available, and expensive

The objective of this study was to develop an imitation cheese product for consumer markets in the Philippines Specific objectives were (1) to determine laboratory panel responses to levels of flavoring and salt in peanut-based imitation cheese spreads, (2) to determine consumer preference and purchase intention for imitation cheese spread formulations, and (3) to compare the quality of imitation cheese spread with three commercially available dairy-based cheese spreads in the Philippines

MATERIALS & METHODS

Peanut paste preparation

Commercially blanched Florunner peanuts (68 kg) (Seabrook Blanching Corp Sylvester GA) were steamed 2 min at 100 C to destroy lipoxygenase dried on wire screens 1 hr at ambient temperature (ca 25 C) comminuted in a Hobart food cutter (Model 84142 Hobart Manufacturing Troy OH) and passed through screens to a final particle size of between 3 36–4 75 mm The chopped peanuts were subjected to a water extraction procedure (Ince 1968), dried at 100°C for 1 hr then at 37°C for 48 hr in a forced air oven (American Instrument Co Silver Spring, MD) Paste was produced by grinding the chopped peanuts in a Morehouse mill (Model M M S Electra Motors Anaheim CA) set at a stone clearance of 1 4 mm After the initial grind 2% hydrogenated shortening (Fix X Procter and Gamble Co Cincinnati, OH) was stirred into the paste and the mixture was ground a second time at a stone clearance of 0 9 mm The paste was packed into 42 × 62 cm plastic pouches (Curwood Specialty Films Oshkosh WI) heat sealed and refrigerated (ca 4°C) until needed

Screening methods for ingredient selection

Initial screening of twelve samples of cheese flavors and dried buttermilk and whey requested from flavor companies was conducted by the senior author Screening was accomplished in two stages In the first stage wicks of filter paper were dipped into all liquid flavorings and smelled Powdered flavorings were first dissolved in water and screened as above Flavorings with disagreeable sharp artificial odors were excluded In the next stage the remaining samples were mixed into approximately 20g paste and evaluated by a panel of four judges experienced in evaluating spreadable peanut products The following characteristics were considered during evaluation (1) intensity of cheese flavor—strong enough to mask the slight peanut flavor in the paste (2) acceptability of the cheese flavor to the expert panel, and (3) odor—with no strong pungent or undesirable odors at concentrations needed to impart a cheese flavor to the paste In round table discussions panel consensus that Natural Cheddar Cheese Flavor Powder WONF Sharp Type (Haarmann & Reimer Corp , Springfield NJ) was the most suitable for the product

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Table 1—Amount of ingredients added to peanut paste in the preparation of six formulations of peanut based imitation cheese spread

Peanut spread formulations / Ingredients	1 wt(g)	%	2 wt(g)	%	3 wt(g)	%	4 wt(g)	%	5 wt(g)	%	6 wt(g)	%
Peanut paste	3000		3000		3000		3000		3000		3000	
Cheese flavoring	240	8	240	8	180	6	180	6	120	4	120	4
Salt	30	1	15	5	30	1	15	5	30	1	15	5
Buttermilk powder	150	5	150	5	450	5	150	5	150	5	150	5
Yellow food color	15 8	0 53	15 8	0 53	15 8	0 53	15 8	0 53	15 8	0 53	15 8	0 53
Annatto extract	1 7	0 06	1 7	0 06	1 7	0 06	1 7	0 06	1 7	0 06	1 7	0 06

Table 2—Mean laboratory panel scores for six formulations of peanut based imitation cheese spread with varying levels of cheese flavor and salt added[a]

	Cheese flavor[a]			Off flavor[b]			Saltiness[c]		
	Added salt (%)			Added salt (%)					
	0 5	1 0	Group mean[d]	0 5	1 0	Group mean[d]	0 5	1 0	Group mean[d]
Added Flavor (%)									
4	3 5d	3 9d	3 7c	3 1a	3 6a	3 4a	4 0c	4 6b	4 3c
6	4 6c	5 1cb	4 9b	3 5a	3 7a	3 6a	4 9b	5 5a	5 0b
8	5 3ab	5 7a	5 6a	3 9a	4 1a	4 0a	5 7a	5 6a	5 4a
Group Mean[2]	4 5	4 9		3 5a	3 8a		4 9b	5 2a	

[a] Mean scores for each of the 6 formulations followed by a different letter are not significantly different at a $p < 0.05$ level
[b] Very weak = 1 Very strong = 7
[c] Very bland = 1 Very salty = 7
[d] Means in the same column or row followed by a different letter are significantly different at $p < 0.05$ level

To obtain a color similar to commercially available cheese spreads a commercial product Cheez Whiz (Kraft Inc , Glenview IL) was used as the standard A mixture of yellow food color (C F Sauer Co , Richmond, VA) and Color Treme A 177 Purified Extract of Annatto (Beatrice Food Ing Inc Beloit, WI) was added to the paste

Extra fine salt (Reese Finer Foods Inc Dayton OH) was used because it could be more evenly dispersed throughout the product To enhance the dairy notes, buttermilk powder was added to the spread Four samples of buttermilk powder were screened by the experienced panel based on (1) acceptability of buttermilk flavor and (2) freedom from off flavors The sample chosen, San A Buttermilk 983 (Beatrice Food Ing Inc Beloit, WI) was made from cultured buttermilk and had a slightly sour note which the expert panel concluded would com plement the sharp cheese flavor

Imitation cheese spread preparation

Samples for the laboratory panel evaluation were prepared by mix ing 5% buttermilk 25 mL yellow food color and 5 mL annatto extract into 780±20g of paste The paste was divided into 6 portions of approximately 130±5g each The remaining ingredients were added to the mixture according to the experimental design for the different formulations A full factorial design utilizing three levels of flavoring (4 6 and 8%) and two levels (0 5 and 1%) of extra fine salt was used

Amounts of the ingredients added were manually mixed into the paste as follows 4% (5 3g) 6% (7 8g), 8% (10 4g) cheese flavor and 0 5% (0 65g), and 1% (1 3g) extra fine salt The spreads were filled into randomly coded souffle cups with lids Sensory tests were con ducted two hours later

Samples used in the consumer panel tests were prepared by mixing approximately 2 4 kg of spread needed for each formulation in a Hobart mixer (The Hobart Mfg Co Troy OH) Amounts of ingre dients for each formulation are shown in Table 1 Ingredients were weighed and mixed thoroughly for 2 min into the paste The spread was filled into souffle cups which were pre labelled with random numbers for each sample covered, and refrigerated until needed for the consumer tests the following day

Laboratory panel evaluation

An experienced laboratory panel composed of 8 students and re search assistants from the Dept of Food Science & Nutrition Univ of the Philippines, evaluated the different formulations of cheese spread (Table 2) Judges were asked to rate the following attributes using 7 point intensity scales cheese flavor (1=very weak, 7=very strong) off flavor (1=very weak 7=very strong) and saltiness (1=very bland 7=very salty) Tests using the laboratory panel were performed to determine whether the panelists could discriminate between the levels of cheese flavor and salt used in the different formulations Difference testing should precede preference testing (Ellis 1968) since if no differences were perceived in the different formulations preference ratings would not be valid

Evaluation was conducted in a sensory laboratory in partitioned booths illuminated by fluorescent lighting Panelists were provided with each of the 6 samples presented in random order Crackers and water were provided and panelists were instructed to consume these between samples Tests were replicated three times

Consumer panel testing

Consumer tests were conducted from the Institute of Food Science and Technology, University of the Philippines in Los Banos Six ran domly coded samples packed into a plastic bag with a wooden spoon and three crackers were distributed to 200 consumer panelists to eval uate at home Panelists were asked to rate each of the six samples using 7 point hedonic scales for overall preference (1=dislike very much 7=like very much) preference for the cheese flavor (1=dislike very much 7=like very much), and a 5 point scale for purchase intention (1=definitely not buy 5=definitely will buy) Responses to sensory ballots were collected after a period of about 4 hr A small gift was provided as an incentive

Panelists were selected on the basis of availability and willingness to cooperate Approximately 20% of the respondents had previously participated in sensory preference tests and although not experienced were knowledgeable about the testing procedures Brief instructions on use of the consumer ballot were given to judges who had not previously participated in sensory preference tests Socio economic and demographic questions regarding sex, age marital status income and occupation were included in the ballot (Table 3)

Comparison with commercial cheese samples

Samples of three commercial dairy based cheese spreads were pur chased from local supermarkets in the Philippines for analysis in the U S The commercially available spreads and all formulations of the peanut based imitation cheese spread were subjected to compositional analyses for moisture sodium chloride protein and oil contents as described below Instrumental texture and color measurements were also obtained Analyses were replicated thrice

Moisture content was determined by weight difference (AACC 1983a) The procedure was modified as follows ca 5 g cheese spread was spread thinly on a 9 cm aluminum moisture vessel lined with ashless filter paper (Whatman No 4 W R Balston Ltd U K) and dried for 12 hr in a vacuum oven (70 C 2 54 mm of mercury) Chlo ride content was determined by the Volhard method (Case et al 1985) Results were reported as % sodium chloride Protein content was measured using the microKjeldahl procedure (AACC 1983b) modified as follows 300 mg spread was weighed onto ashless filter paper (Whatman No 2) and the nitrogen content of the filter paper used as the blank A factor of 5 46 was used to convert nitrogen

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Table 3—Mean demographic characteristics of consumer panel

Group characteristics	Total sample (%) (n=200)
Age	
< 18	1
18 25	20
26 40	60
41 60	18
> 60	1
Sex	
Male	29
Female	71
Marital Status	
Single	44
Married	55
Separated/Widowed	2
Monthly Income [b]	
<P2 999	26
P3 000 P6 999	45
P7 000 P12 999	11
P13 000 P16 999	2
>P17 000	17
Occupation	
Professional/Faculty	36
Technical/Clerical	61
Student	3

[a] Percentages may not be equal to 100 / due to rounding of numbers
[b] Conversion factor P20 = US$ 1

Table 4—Compositional analyses and a_w of six formulations of peanut based cheese spread and three commercial cheese spread products[a]

Sample	Protein (%)	Moisture (%)	Oil (%)	Sodium chloride (%)	a_w
	Compositional measures				
Commercial spreads					
A	10 8d	51 8b	43 0e	1 8b	0 98a
B	11 4d	52 7a	46 4d	1 2d	0 99a
C	13 9c	48 3c	41 8e	1 7bc	0 97a
Peanut based spreads					
(% Salt/% flavoring)					
1 (1 8)	24 4a	4 4d	51 6abc	2 2a	0 42bc
2 (0 5/8)	24 1a	4 2d	50 5bc	1 6c	0 41c
3 (1/6)	23 8ab	4 2d	50 2c	1 7bc	0 43bc
4 (0 5/6)	24 0ab	4 6d	51 9abc	1 2d	0 43bc
5 (1/4)	23 5b	4 3d	52 5ab	1 4d	0 43bc
6 (0 5/4)	23 8ab	4 4d	53 a	0 9e	0 44b

[a] Means in the same column followed by different letters are significantly different at the p < 0 05 level

content to protein values (FAO, 1970) Oil was extracted using the Goldfisch apparatus with petroleum ether as solvent Extraction was carried out for 12 hr and the sample dried in a vacuum oven (70 C 2 54 mm of mercury) for 2 hr prior to weighing Oil content was expressed as percent dry weight

Water activity was measured using a Beckman 10–100% r e m sensor (Model EBS) and recorder (Hydroline flat bed model VFB Beckman Instrument Inc Cedar Grove NJ) Lithium chloride mag nesium chloride magnesium nitrate, sodium chloride and potassium nitrate salts were used to calibrate the sensor based on a constant room temperature of 23 8 C Approximately 15 g cheese spread was placed into a clear plastic vessel measuring 39 mm in diameter by 11 mm deep The recorder speed was set at 10 inches per hour

Color was measured using a Gardner Color Difference Meter, Model XL 845 (Gardner Laboratory Division, Bethesda MD) set against a standard yellow color tile (L=79 56, a= −2 17 b= +22 98) Cheese spreads were spread evenly on the sample cup to a depth of approx imately 13 mm the sample cup was kept covered when measurements were made L a and b values for each sample were determined in triplicate Values for a and b were used to calculate hue angle ($\tan^{-1}$ b/a)

Texture was measured using a Universal Testing Instrument (Model 1122 Instron Corp , Canton MA), following the procedure by Ahmed and Ali (1986) modified by setting the crosshead speed at 20 mm/min and recorder chart speed at 100 mm/min, and using a sample holder measuring 5 0 cm in diameter and 2 2 cm deep Area (mm^2) of the second peak was measured using a digitizer and converted to joules to represent the work necessary to remove the sample from the plunger surface Width (mm) of the second peak was measured and converted to time (sec) which represents the time required to break a column of paste that forms between the plunger and the sample surface (Ahmed and Ali 1986)

Statistical analysis

Data were analyzed using procedures of the Statistical Analysis System (SAS 1985) Mean sensory scores were subjected to analysis of variance (ANOVA) The frequency procedure (FREQ) was used to group demographic characteristics of the consumer panel

RESULTS & DISCUSSION

Laboratory panel tests

Results of the laboratory panel tests are shown in Table 2 These indicate that the panel was able to detect differences in the levels of flavoring and salt added to the paste Scores for cheese intensity and saltiness were significantly different and increased with higher levels of added flavor and salt, respectively

Mean sensory scores related to the categories on the rating scales are as follows flavoring added at a level of 8% corresponded to 'moderately strong' and 'slightly strong', 6% to 'slightly strong' and 'neither weak nor strong', and 4% to 'neither strong nor weak' and 'slightly weak' Scores for both levels of salt, 0 5% and 1%, corresponded to 'neither salty nor bland' and 'slightly salty', respectively

As the level of added cheese flavor increased in the paste, formulations were rated by laboratory panelists as higher in both cheese flavor intensity and saltiness These findings indicate that the flavoring used may have contained a significant amount of salt, thus the addition of flavoring increased the saltiness of the product as well as the cheese flavor Results of chemical analysis for salt content presented in the compo sitional analysis (Table 4) supports this finding

No significant differences were found in the mean scores for off flavor at different levels of flavoring and salt Mean scores ranged from 4 0 to 3 1 and correspond to the 'neither strong nor weak' to 'slightly weak' categories on the off-flavor intensity scale The perception of off-flavor described in the

Table 5—Mean sensory scores of the consumer panel for six formulations of peanut based imitation cheese spread with varying levels of cheese flavor and salt added

	Overall preference[b]			Cheese preference[b]			Purchase intention		
				Added salt (%)					
	0 5	1 0	Group mean[d]	0 5	1 0	Group mean[d]	0 5	1 0	Group mean[d]
Added flavor (%)									
4	4 2ab	4 4a	4 3a	4 3a	4 5a	4 4a	2 7a	2 8a	2 7a
6	4 3a	4 2ab	4 2ab	4 3a	4 3a	4 3a	2 8a	2 9a	2 9a
8	4 1ab	3 9b	4 0b	4 2a	4 0a	4 1a	2 8a	2 6a	2 7a
Group mean[b]	4 2	4 2		4 3a	4 3a		2 8a	2 8a	

Mean scores for each of the six formulations followed by a different letter are not significantly different at a p < 0 05 level
[b] Dislike very much = 1 like very much = 7
[c] Definitely will not buy = 1 Definitely will buy = 5
[d] Means in the same column or row followed by a different letter are significantly different at a p < 0 05 level

comments section of the sensory ballot varied among panelists as some described the off flavor as 'sour' or 'acidic', while others perceived this as being the peanut flavor of the paste While cheddar cheese is available in the Philippines, most commercial cheese products have a mild flavor, therefore, panelists unaccustomed to the sharp cheddar flavor may have perceived it as sour

Consumer panel evaluations

The demographic profile of the consumer panel is shown in Table 3 The panel was composed mostly of females (71%) and 80% of the panelists were between 18 and 40 years of age There were slightly more married than single respondents, 55% and 44%, respectively The monthly household income of 45% of the panelists was P3,000–6,999 ($150–350) which classifies them in the middle income range in the Philippines About 61% held positions of a technical or clerical nature, while the remaining third were mostly professionals

Means scores of the consumer panel for overall preference, cheese flavor preference and purchase intention are presented in Table 5 Responses for cheese flavor preference and purchase intention were not significantly different Cheese preference ratings of 4 1 to 4 5 correspond to 'like slightly' and 'neither like nor dislike' on the 7-point scale Purchase intention scores of 2 6 to 2 9 on a 5-point scale correspond to 'undecided' and 'definitely will not buy'

Overall preference scores were significantly different for varying flavor levels and among the six samples Mean scores were highest, though not significantly different, for the 4 and 6% flavoring levels When individual formulations were compared, the samples containing 0 5% salt and 6% flavoring and 1% salt and 4% flavoring received the highest in overall preference scores Mean ratings of 4 0 to 4 4 correspond to the 'like slightly' and 'neither like nor dislike' points on the overall preference scale

Comparison of imitation cheese spread and commercial samples

Compositional analyses Results of the six peanut based imitation cheese spread formulations and three commercially available spreads are given in Table 4 All peanut based cheese spread formulations had significantly higher protein content that the commercial cheese spreads Values for the peanut-based spread ranged from 23 5 to 24 4%, and were nearly twice as much as those for the commercial samples The high protein content provided by the peanut based spreads is an important justification for its development in underdeveloped countries where protein intake may be marginal The use of such a product with bread results in protein complementation that further increases the nutritive value of this product as consumed

Moisture content for the commercial samples ranged from 48 3 to 52 7% (average a_w 0 98) At this water activity level, these foods are highly perishable and readily support the growth of most bacteria and fungi (Beuchat, 1981), thereby requiring refrigeration to prolong shelf life Moisture content of the peanut-based spreads were between 4 2 and 4 6% Corresponding water activity measures averaged 0 42 At low levels of water activity, the growth of microorganisms is reduced (Corry, 1978) and, unlike its commercially prepared counterparts, the product would have the added advantage of being microbiologically shelf stable

Oil content, expressed as percent dry weight, was also significantly higher in the peanut based samples than in the commercial spreads While caloric restriction is recommended for westernized societies, it is beneficial to increase the total calorie content of the diet in nations where protein-calorie malnutrition is prevalent This product would provide added calories to the diet

Sodium chloride content of the commercial samples ranged from 1 2 to 1 8% Values of the peanut based spreads varied more widely due to differences in formulations

To determine compositional differences between the six peanut-based spread formulations, analysis of variance was performed (data not presented) Differences in the amounts of salt and flavor added resulted in significant differences in the protein and sodium chloride contents of the spread but not in oil and moisture levels Both protein and sodium chloride contents of the spreads increased as flavoring level increased indicating a contribution to these components by the particular cheese flavoring used

Analysis of variance of the sodium chloride content of six samples revealed that samples 2 (0 5% salt, 8% flavoring) and 3 (1% salt, 6% flavoring), were not significantly different, as were samples 4 (0 5% salt, 6% flavoring) and 5 (1% salt, 4% flavoring) These results indicated that the flavoring contained a significant amount of salt and supported the sensory results from the laboratory panel which showed saltiness to increase with higher flavor levels

Texture Data obtained from the instrumental texture measurements are shown in Table 6 No significant differences were found in work values of both commercial and peanut-based cheese spreads Time was not significantly different among the peanut based formulations However, a wide variation was seen in time values of the commercial samples, indicating that the texture of commercial samples varied widely

Instrumental color Values for lightness L and hue angle are also given in Table 6 The commercial spreads and formulation 1 of the peanut based spreads were lighter in color (higher L values) than the other peanut-based formulations The commercial spreads had a lower hue angle and a more orange hue than the peanut based spreads

Although an identical amount of coloring agent was added to each formulation, analysis of variance performed on the peanut based formulations alone showed significant differences in L and hue angle values (data not presented) The varying amounts of flavoring and salt added to the formulations would explain the difference in color measurements obtained

Table 6—Mean instrumental color and texture measurements for six formulations of peanut based cheese spread and three commercial cheese spread products

Sample		Instrumental measures for Texture: Work[b] (J × 10^{-3})	Texture: Time[c] (sec)	Color: Lightness (L)	Color: Hue angle ($\tan^{-1}$ b/a)
Commercial spreads					
A		2 5a	41 4a	64 7a	68 0d
B		2 1ab	32 4b	63 8b	59 5e
C		2 5a	11 1d	63 4b	67 4d
Peanut based spreads (% salt/ % flavoring)					
1	(1/8)	2 1ab	17 4c	63 5b	77 0a
2	(0 5/8)	1 2ab	12 9cd	62 6c	76 2ab
3	(1/6)	2 1ab	16 5cd	61 8d	75 4cb
4	(0 5/6)	1 4ab	12 9cd	61 6d	74 8c
5	(1/4)	0 9b	11 4cd	62 2cd	75 6bc
6	(0 5/4)	2 0ab	14 4cd	62 2cd	75 9b

[a] Means in the same column followed by different letters are significantly different at the $p < 0.05$ level

[b] Work necessary to remove sample from plunger surface (Ahmed and Ali 1986)

[c] Time required to break column of paste that forms between the plunger and the sample surface (Ahmed and Ali 1986)

CONCLUSION

CONSUMER PREFERENCE TESTS on six formulations of peanut-based imitation cheese spreads using a consumer panel of 200 Filipinos indicated equal preference for samples containing combinations of 0 5% salt/6% flavoring and 1% salt/4% flavoring Use of the combination containing the higher salt and lower flavoring level in commercial applications would

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help reduce costs of this peanut based cheese product, since cheese flavoring is a more expensive ingredient than salt

Results of this study indicate the potential for the development of a peanut-based imitation cheese spread Superior nutritional content and anticipated shelf stability are only two of the advantages such a product would have over the commercially available samples Use of good quality, locally grown peanuts as a replacement for imported dairy ingredients would make the product less expensive than its dairy counterpart Production of the paste does not require the use of sophisticated processing equipment, and thus would be appropriate for implementation in a developing country like the Philippines

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