Development of Black Pepper Incorporated Processed Cheese Spread for the Local Market

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Abstract: Incorporation of spices to processed cheese is a value added product in Sri Lankan market. Incorporation of pepper is a new trend in traditional processed cheese spread increases consumer preference as well as provides health benefits to human being. Objectives of this research studies were developing low cost pepper incorporated processed cheese spread with higher sensory quality for local market and evaluate chemical, microbiological stability of the manufactured product for it's keeping quality. This study was continued from already partially finished research study. Initially two treatments were developed to obtain proper formula of processed cheese spread. Observed quality defects like poor spreadability, peppery taste were overcome in rest of three treatments through incorporation of fresh cream (750 ml, 650 ml, 850 ml), vegetable fat (250 g, 300 g, 300 g) and black pepper powder (4%, 3%, 2%) in treatment 3, 4 and 5 respectively. Prepared samples were filled in to PET jars and stored at both room temperature and refrigerated temperature for sensory, chemical and microbiological analysis. Quality attributes were analyzed using 30 panelists each through hedonic test. Ranks were analyzed using MINITAB14. P value < 0.05 in some quality characters such as spreadability, flavor and overall acceptability among treatments show the significant different among treatments. Treatment 4 was selected as the best treatment and control (onion flavored kotmale brand cheese spread) presence in the local market were used to sensory analysis through hedonic test. There were no significant different observed in quality attribute except flavor (p value < 0.05). As chemical parameters pH, moisture content, titratable acidity and as microbiological parameters total plate count, yeast and molds, coliforms were measured periodically to evaluate shelf life of the product developed for marketability.
Keywords: Processed Cheese, Cheese spread, pepper incorporation

1. INTRODUCTION

Milk contains not less than 8.25 % of milk solid nonfat and not less than 3.25 % of milk fat. Since it contains high amount of nutrient thus microorganisms can grow easily in raw milk. Cheese can be considered as an ancient form of food preservation due to exclusion of whey and maturing process during manufacturing. Processed cheese is a product obtained by heat melting and mixing of natural cheese with suitable emulsifiers. Processed cheese is made by further processing of natural cheese usually with different aromas and degrees of maturity. Processed cheese can be categorized in to two types known as cheese blocks with a firm consistency, high acidity, relative low moisture content and cheese spreads with a soft consistency, low acidity, high moisture content but various flavoring can be added (Fox, P. F 2000). It contains 30% or 45% fat, counted on total solids. Cheese for processing is of the same quality as cheese for direct consumption and cheese with defects regarding surface, color, texture, size and shape as well cheese with a limited shelf life can also be used for processing. Incorporation of spice like pepper to the cheese spread is having more that taste variation among consumers. it contains high amount of moisture results high water activity (> 0.8). It induces the growth of micro flora especially mold and bacteria which are mostly associated with food spoilage (Koikowski, F., 1982). So it has high chance of deterioration under favorable condition. MILCO (Pvt) Ltd initiated manufacturing of process cheese spread locally but the keeping quality of the product was not acceptable due to poor spreadability, high sweetness and mold growth within a short period of time. Thus there is a need to develop a local processed cheese spread with high higher sensory qualities and longer shelf life Therefore this study was carried out to accomplish the following objectives.

Objectives
1. To manufacture pepper incorporated processed cheese spread with higher sensory quality at low cost for local market
2. To evaluate chemical and microbiological stability of the manufactured product for it is keeping quality or shelf life.

2. METHODOLOGY

Preparation of raw materials
Initially fresh cream containing 36% of fat was prepared using Pierson square method of standerdization. Black pepper was washed with chlorinated water (200 ppm) and immersed in boiled water for 15 min. Then they were dried using in an oven (NB-6302E, National, Japan) and ground using a dry grinder (4HIXGR, Sisil, India). Manufacturing of cheese spread, chemical and microbiological analysis and shelf life evaluation were done at MILCO (Pvt) Ltd., Digana, Sri Lanka.

Processing and packaging
Ingredients were transferred in to a steam jacketed kettle (Stepehon, FD112, West Germon) and cooked at $195°F$ ($90.6°C$) for 3 min. Prepared cheese was filled into sterilized food grade PET jars with a capacity of 175 g each. As mentioned above five treatments were prepared and stored in

both room temperature and refrigerator temperature (4°C). Initially first treatment was prepared and observed for the improvement of cheese spread. Two major defects were observed in first treatment. Those are small particles of cheese and watery appearance in final product. To overcome these problems amount of sodium citrate was increased and amount of water was cut down into half during second

treatment preparation. Amount of vegetable fat and fresh cream were changed in rest of the 3 treatments to improve the spreadability of the processed cheese. Incorporation of black pepper started at second treatment (5%) and amount was reduced from 5% to 2% gradually (4%, 3%, 2%) in treatment 3, 4 and 5.

Table 1 Different treatments of pepper incorporated spread cheese

Ingredients	Treatments				
	1	**2**	**3**	**4**	**5**
Ripened Cheese (g)	450	450	450	550	550
Unripened Cheese (g)	450	450	450	450	450
Fresh cream (ml)	650	650	750	650	850
Sodium citrate (g)	15	25	25	25	25
Trisodium phosphate(g)	2.5	2.5	2.5	2.5	2.5
Citric acid (g)	5.0	5	5	5	5
table salt (g)	25	25	25	25	25
Potassium sorbate (g)	2.5	2.5	2.5	2.5	2.5
Vegetable fat(g)	250	250	250	300	300
Palsgaard (g)	20	40	40	40	40
Water (ml)	80	40	40	40	40
Black pepper (%)	-	05	04	03	02

Sensory evaluation for the selection of the most acceptable sample

Five different treatments were prepared as shown in Table 1 and evaluated for 5 quality attributes namely color, flavor, texture, spreadability and overall acceptability using a 9 point hedonic scale. Thirty untrained panelists were used from Digana factory and Faculty of Agriculture, University of Peradeniya. Among 5 treatments last 3 treatments were used for sensory analysis. For each quality attribute separate panels were prepared to get the results. The data was analyzed using non-paramatric Friedman test by MINITAB 14.

Physico-chemical analysis of components

Percentage of fat, total solid, solid non fat (SNF), titratable acidity, pH, moisture content, percentage of ash of final products were measured. Titratable acidity, pH, moisture content were measured every week up to six weeks. Standard methods were used to analyze the components. pH was measured using pH meter (TOA Electronic Ltd, Japan).

Microbiological analysis

Total plat count, coliform count (SLS 516: Part 3: 1991), yeast and mold count (SLS 516: Part 2: 1991) were measured every week up to 6 weeks according to the standard procedure.

Evaluation of shelf life

The shelf life determination was carried out for selected treatment of pepper incorporated spread cheese. The samples

were kept at room temperature for a period of 5 days. The samples kept at refrigerator (4°C) was used to analyze pH, titratable acidity and microbiology at one week interval up to six weeks.

Cost analysis

Cost of raw material for each treatment was calculated using the data available in the account branch of Digana factory.

3. RESULTS AND DISCUSSION

Preparation of treatments

Initially first treatment was prepared and observed for the improvement of cheese spread. Improper emulsification and watery appearance in final product were observed as major defects. Increase the amount of sodium citrate, palsgaard and cut down of water into half during second treatment provide better quality cheese spread (Muir, D.D., 1998). Incorporation of different level of vegetable fat and fresh cream in rest of the three treatments improved the spreadability of the cheese

Chemical analysis of processed cheese spread

Chemical analysis was done to all five treatments formulated during research and values obtained are listed in Table 1. These values were compared with Sri Lankan Standard (SLS). All the treatments prepared during research were within the range of SLS of chemicals. Fat content of fifth treatment was comparatively high due to incorporation of more vegetable fat and fresh cream compared to other treatments. According to sensory analysis the treatment 4 was selected as the best treatment for marketability. Moisture content maintained around 55% but standard is

between 30-80%. Fat (Dry basis) content of the selected treatment is 44.55% very close to SLS (45%).

Microbiological analysis of processed cheese spread
Initial microbiological content of the selected best treatment in final studies shown in Table 4 According to results of Microbiological analysis the selected treatments is

conforming to the specification of Sri Lankan Standards. With the time microbiology of cheese spread was evaluated to measure the shelf life of the cheese spread.

Table 2 Average chemical compounds of five treatments

Chemical analysis (%)	Treatments				
	1	**2**	**3**	**4**	**5**
Moisture content	67.89	58.36	55.58	55.45	50.96
Total solid	42.11	41.64	44.42	44.55	49.04
Fat %(wet basis)	15	15	15	20	23
Fat% (dry basis)	35.62	36.02	33.76	44.80	46.9
Solid Non Fat (SNF)	27.11	26.64	29.42	24.55	26.04
pH	6.0	6.11	6.3	6.21	6.1
Titratable acidity	0.70	0.70	0.80	0.75	0.75

Sensory evaluation of organoleptic characters
Thirty untrained panelists conducted the hedonic test. According to results of the tasting panel estimated hedonic medians and sum of ranks for each quality character are tabulated in Table 4.4 and 4.5 Estimated median values are shown as bar chart in Figure 1 which provide some idea about significant different among treatments in organoleptic characteristics.

Probability values of quality attributes show that there are significant different present among treatments. Probability values of color and appearance are 0.223 and 0.962 respectively. These values are greater than 0.05 which imply there is no any significant different in color and appearance among three treatments. P values of flavor (0.001), spreadability (0.001) and overall appearance (0.001) are less than 0.05 imply there is significant different present among treatments.
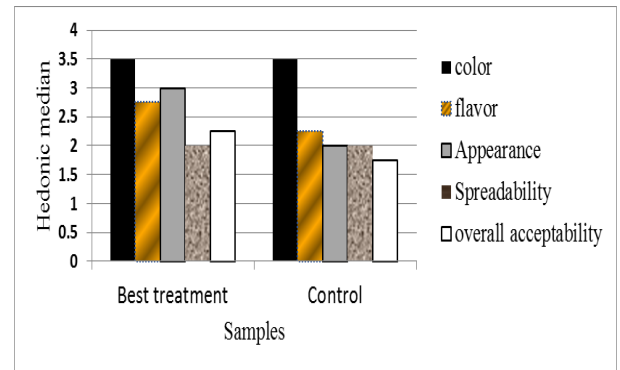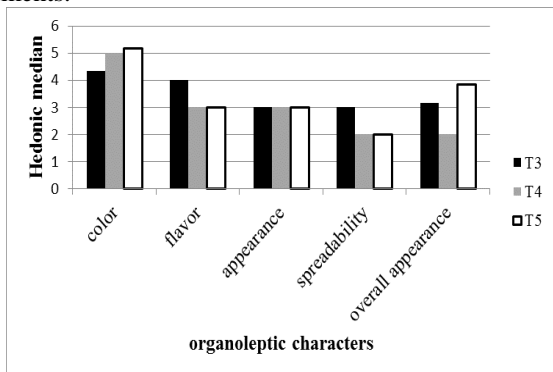

Figure 1 Hedonic median of treatments

Figure 2 Hedonic median of Best treatment and Control

Sums of rank and hedonic median are used as a criteria to select the best treatment among these three treatments. Treatment 3 is simply rejected due to its high sums of rank and hedonic median. Treatment 4 was selected as the best treatment because of its better quality characters except color. Hedonic median of color in selected treatment in final studies is 5 which says in phrase neither like nor dislike the color of cheese spread. Color can be improved using β-carotene colorant available in Digana factory. Carotene insoluble in water but soluble in oils, fats and hexane (Henssen and Marsden,1988). So β carotene easily dissolve on these treatments and can be produced spread cheese with attractive color by further research studies.

Hedonic median of flavor and appearance of selected treatment is 3 which says in phrase moderately like these characters. By improving color of the product can increase quality of appearance in the final product but to get proper flavor have to incorporate cheese flavor present in local market. Cheese flavor cannot purchase in small amount. It available only in bulk amount (10 kg). Due to high cost of bulk purchasing it was not incorporated in this research studies. Hedonic median of spreadability and overall acceptance are 2 which says in phrase like the product. By

changing minute changes in ingredients can improve further in future experiments.

Comparison of quality attributes of processed cheese spread

Treatment 4 which was selected as the best treatment was compared with onion flavored processed cheese of Kotmale dairy products (Pvt) Ltd. available in the local market. Thirty untrained panelists participated in the sensory evaluation.

Cost analysis of selected treatment.

Cost analysis of raw materials taken in to account using data available in accounts branch of MILCO (Pvt) Ltd. Maximum cost of production for the selected treatment is Rs.550 per 1 kg. The price of control available in the market is Rs.1300 per 1 kg (Kothmale cheese spread Rs.260 per 175g). Formula available in the factory cause high cost compare with newly formulated formula because old formula include butter, skimmed milk powder and whey powder which are highly cost raw materials.

Table 3 Chemical evaluation of processed cheese spread

Weeks	pH		Titratable acidity		Moisture %	
	S1	S2	S1	S2	S1	S2
1st week	6.01	6.00	0.73	0.69	54.45	55.45
2nd week	-	5.99	-	0.69	-	55.45
3rd week	-	5.98	-	0.71	-	54.35
4th week	-	5.97	-	0.72	-	54.11
5th week	-	5.90	-	0.74	-	54.00
6th week	-	5.80	-	0.77	-	53.25
7th week	-	5.75	-	0.79	-	53.00

During seven weeks time the titratable acidity slightly increased while moisture content and pH values slightly decreased. According to chemical changes shown in Figures 3 and 4 below can come to a conclusion about the product which can be used minimum of another four or five weeks without any problem. There were no any drastic deterioration of chemical compounds were observed in the product. Totally product can be used minimum of twelve weeks (Three months) without any drastic quality deterioration according to curve of figures shown below.
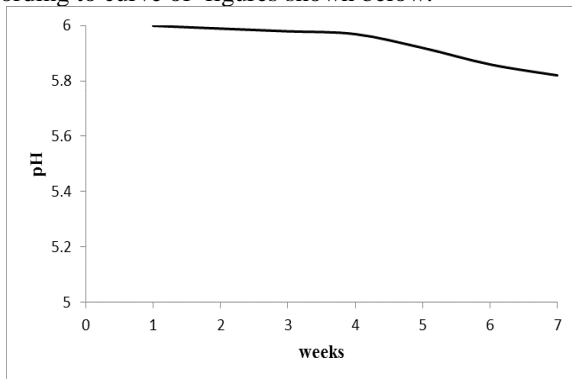

Figure 3 Changes of pH during storage

Shelf life evaluation

The selected treatment was evaluated each week chemically as well as microbiologically to get idea about shelf life of the product. As chemical parameters moisture content, pH, titratable acidity were measured periodically and as microbiological parameters Total plate count, yeast and mould count and coliforms were evaluated for a period of 7 weeks. According to Table 4 chemically cheese spread did not deteriorate chemically up to seven weeks which stored at refrigerated temperature (S1) but sample stored at room temperature (S2) deteriorated during analysis of second week.

Due to time limitation of research different graphs are drawn using data of available seven weeks to estimate approximate shelf life of the product. Table 4 describes pH, moisture content and titratable acidity change in every week respectively.
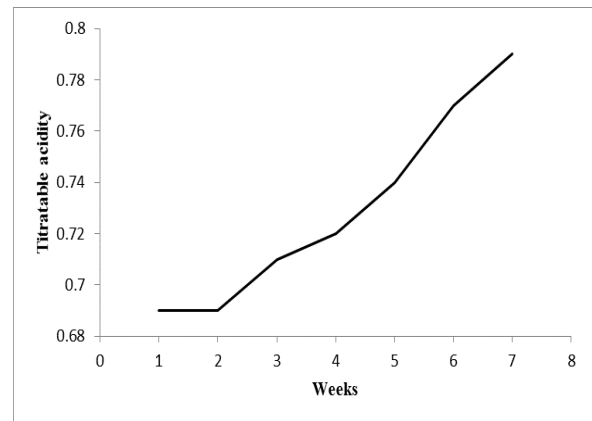

Figure 4 Change of titratable acidity during storage

Microbiological evaluation of refrigerated sample is shown in Table 4 Sample which was stored at room temperature was discarded in second week due to too many colonies of Total plate count and yeast and mold. Refrigerated sample was evaluated continuously up to seven weeks. According to evaluation of seven weeks different graphs were drawn to find out approximate shelf life of the product in terms of microbiology. Table 4 shows the microbial changes of yeast and mold and Total plate count, respectively. Coliforms were absent in the product according to Sri Lankan Standard.

Table 4 Microbiological evaluation of processed cheese spread

WEEK	TOTAL PLATE COUNT		YEAST AND MOLD		COLIFORMS	
	SI	S2	S1	S2	S1	S2
1	$2.9*10^2$	$2.2*10^2$	13	13	Absent	Absent
2	-	$2.2*10^2$	-	13	Absent	Absent
3	-	$3.2*10^2$	-	16	Absent	Absent
4	-	$4.8*10^2$	-	20	Absent	Absent
5	-	$5.6*10^2$	-	22	Absent	Absent
6	-	$6.3*10^2$	-	24	Absent	Absent
7	-	$7.5*10^2$	-	25	Absent	Absent

S1: Sample stored at room temperature   S2: Sample stored at refrigerated temperature

During seven weeks time total plate count and yeast and mould count has slightly increased in refrigerated condition. However microbial range within the Sri Lankan Standard.

4. CONCLUSION

Newly developed processed cheese spread has equal sensory qualities when compare to regular cheese spread available in the market. According to shelf life evaluation can estimate developed product could be kept until 3 months without any drastic quality defects like regular product. According to cost analysis, it is very low cost compare with already existing formula in MILCO factory as well as other products available in local market. Incorporated black pepper act as an antioxidant and provide health benefits to the product.

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