

Effect of different condiments and salt concentration on physico-chemical, microbiological and sensory properties of yoghurt spread

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ABSTRACT

An investigation was carried out to determine the effects of various condiments (mint, curry leaves and green chilli @ 2.50% paste) and salt concentrations (1.00%, 1.25%, 1.50% and 2.00%) on proximate, microbiological and sensory attributes of yoghurt spread. Yoghurt was prepared with NCDC 263 culture. Significant differences were observed between the condiments used in respect of total solids (TS) ($P < 0.001$), moisture ($P < 0.001$), protein ($P < 0.01$) and fat ($P < 0.05$) of the product. Salt concentrations, however, had a significant difference only on ash content ($P < 0.001$). The average pH and titratable acidity (TA) of yoghurt spread were 4.80 and 0.411% lactic acid (LA), respectively. The total aerobic count of the samples proportionately decreases with increase in salt concentration. Tucky's HSD test showed significant impact of interaction between the condiments and salt concentration with respect to all sensory parameters. Superior overall ratings for yoghurt spreads containing Curry Leaves with 1.50% salt concentration is reported.

Key words: Eating quality characteristics, Physico-chemical, Total aerobic count, Yoghurt spread.

Today's consumer relies mostly on taste, convenience and health promoting products. As a result of which numerous ready to eat cheese spread, mayonnaise, etc. are available in the market which are consumer friendly and can be used as a topping on bread, burger, roti or pizza, etc. Food spreads are used on regular basis as convenience foods due to paucity of time in food preparation. Yoghurt spread is a product which requires less time for preparation and can be used as a spread/topping on snacks, breads, etc. Consumers now-a-days prefer foods with added health benefits, yoghurt being one of them. Several yoghurt based products are readily available in the market where fruits or vegetables, bioactive food ingredients, or edible

fibers are incorporated to add a variety to the end product together with health benefits⁵. Recently,¹⁸ demonstrated that yoghurt is effective as capsules for the administration of probiotics. Now-a-days, as consumers demand flavourful natural foods with health benefits²⁰ hence, new product range and flavour innovations are important in encouraging consumer trials and subsequent category growth⁴. Thus the main aim of the present study is to develop a yoghurt spread, with selected condiments (mint, curry leaf and chilli), with acceptable sensory attributes and also to study their effect at different salt concentration on their physico-chemical, microbiological quality and sensory properties.

MATERIALS AND METHODS

Homogenized and pasteurized toned milk, procured from Purabi Dairy (West Assam Milk Producers Co-operative Union Limited), Assam, India containing 3.0% milk fat (minimum) & 8.5% SNF (minimum) was inoculated with NCDC 263 (*L. delbrueckii* ssp *bulgaricus* and *Streptophillus thermophiles*) mixed culture (obtained from NDRI,

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Karnal, India) @ 1% level and incubated at 42°C for 6 – 8 hours or till setting of the curd. The set curd was subsequently strained through a muslin cloth and hung overnight for complete removal of whey at 4±1°C. Condiments viz., chilli, curry leaves and mint, procured from nearby local market were added as paste, @2.5% to the drained curd. Salt @ 1.00%, 1.25%, 1.50% and 2.00% were mixed thoroughly to have uniformity in the product. Yoghurt spread was then blended thoroughly in a blender and stored at 4±1°C for 4 hours before serving it to taste panel members. The sample was analysed for various physico-chemical parameters, viz., total solid (TS), moisture, protein, fat, ash, pH, titratable acidity and microbiological parameters. For each treatment group, three replications were done and analysed accordingly.

Physico-chemical analysis

TS, moisture and ash content of yoghurt spreads was determined by the methods given by D.G. of Health Services, Ministry of Health & Family Welfare, Govt. of India, New Delhi (2005). Protein was determined by automatic Kelplus Classic DX VA (Pelican Instruments) and nitrogen was converted to protein percent by multiplying with the factor 6.38. Fat was estimated by means of Soesplus SC04E (Pelican Equipments). Titratable acidity, as percent lactic acid, was estimated as per standard procedure¹. A digital bench pH meter 510 (Eutech Instruments Ltd) was used to determine pH of the test samples.

Microbiological quality

Total Viable Count (TVC) was determined by following standard procedure⁸ and TVC was expressed as cfu/ml of the yoghurt spread. Plating was done only after the samples were kept at 4±1°C for 4 hrs.

Sensorial evaluation

A nine-point hedonic scale, (1 = “extremely unpleasant”, 6 = “highest in good category” and 9 = “highest in very good category”), was used to evaluate the samples by 9 membered semi trained panelist. Approximately 50 gm of each sample was

spread on a piece of bread using a plastic spoon (Fig. 1)¹⁵ and offered for sensory evaluation.

Statistical analysis

Statistical analysis was performed by using SAS 9.3. Comparison were accomplished by ANOVA followed by Tucky's HSD test and results were expressed as mean values with standard errors.

RESULTS & DISCUSSION

Physical properties

In the present study the pH of the yoghurt spread reduced from initial 6.6 pH to 4.60 to 4.90 which is in accordance to the findings of³ who reported the range of pH in flavoured spreadable yoghurt to be as 4.69 to 4.91. However, in the present study, the findings are somewhat higher than¹³ who observed a pH range of 4.28 to 4.30 in yoghurt spread containing 2% mint or ginger and 6% cucumber. Slightly higher pH values recorded in the present study might be because of the effect of condiments and varied concentration of salt being used and their effect on the fermentation capacity of the starter cultures. According to¹² higher pH value of spreadable yoghurt may be due to incorporation of additives. They reported 4.83 ± 0.067 mean pH value for mint added spreadable yoghurt.

The yoghurt spreads showed an acidity of 0.411% lactic acid which was similar to the findings of^{17,14} observed an increase in acidity content of soya cheese spread from 0.15% to 0.24% lactic acid. Certain other factors also attribute to the rate and quantity of lactic acid being produced and reduction of pH to pH_u. These may be initial milk quality, extent of degradation of sugar during heat treatment, buffering action of protein, citrate, lactate, phosphate¹⁰ etc; fat, milk solid-not-fat and sugar concentration in milk⁷ and the incubation temperature¹⁹. Several researchers have indicated a decrease in pH of yoghurt spreads along with advancement of storage period^{3,11}.

Proximate composition

In the present study the mean aggregate maximum value for total solids, moisture, protein, fat and ash were recorded as 25.44±0.43, 74.56±0.43,

9.10±0.21, 9.68±0.32 and 1.99±0.07, respectively. Yoghurt spread prepared with adding mint leaves paste (@2.5%) showed highest mean aggregate value for total solids, protein and ash content while curry leaves for moisture and chilli for fat content of the yoghurt spread. The results obtained for fat and ash content in the present study were in accordance to the findings of¹³ who reported fat in the range of 6 to 10% and ash 1.7 to 2.6%. However, the moisture content of the yoghurt spread prepared with various condiments and varied salt concentration was found to be quite high. This might be because of using fresh chilli, curry and mint leaves to the yoghurt.

Significant differences between condiments for total solid content ($P < 0.001$) is evident while no any significant difference could be observed between salt concentration and total solid content in the yoghurt spread prepared. Mint leaf added yoghurt spread exhibited highest total solid content (27.03 ± 0.75)³ also reported average total solid content of mint added spreadable yoghurt to be 28.01 ± 0.6 . Similar findings were also reported by various researchers^{2,9,16}. However, Tucky's HSD test indicates significant impact of interaction between condiments used and salt concentration on total solid content.

Maximum mean aggregate protein content was exhibited by mint leaves added yoghurt spread (9.91 ± 0.40) with lowest value being shown by yoghurt spread containing chilli (8.43 ± 0.16). Significant difference was observed between the mean at $P < 0.01$.

Microbiological quality

A general trend in the number of aerobic organisms could be observed in the study. Along with an increase in the salt concentration of the yoghurt, the number of aerobic count proportionately decreases. However, yoghurt spread with chilli paste showed a higher aerobic bacterial count even at 1.00% level of salt ($8.597 \log_{10}$ cfu/ml) while the least number was recorded for mint added yoghurt spread ($6.501 \log_{10}$ cfu/ml). These findings are in accordance to the findings of²¹.

Sensory evaluation

The mean score attributes to all the sensory parameters viz., appearance, colour, body & texture, flavour, taste and overall acceptability was above 6.0 indicating that the yoghurt spread with various condiments were well accepted by the semi-trained panellists. Colour is the first sensory characteristics perceived by the consumer which ultimately affects the scoring for flavour and aroma⁶.³ reported more green colour for yoghurt spread with mint. However, in the present study chilli exhibited better colour rating along with flavour and taste followed by curry leaves for appearance and mint was recognized for superior body & texture of the yoghurt spread.

In the present study, yoghurt spread with 1% added salt enjoyed highest rating for appearance, colour, body & texture, flavour and overall acceptability while taste was rated best at 1.50% salt concentration, respectively. Curry leaf containing yoghurt spread samples was rated the best for average overall acceptability (6.94 ± 0.10).¹³ reported enhanced flavour in yoghurt spread by incorporating mint (2%), ginger (2%) and cucumber (6%). Reports of enhanced overall acceptability scores of yoghurt samples on addition of fruits was also reported by^{2,16}.

CONCLUSION

Yoghurt spread prepared with inoculation of starter culture and incorporating different herbs/condiments and varied levels of salt concentration do influence the eating quality attributes of the products. Significant interaction of condiments and salt concentrations with respect to all sensory parameters indicated possibility to recommend Curry Leave at 1.50% salt concentration for appearance and taste, while the same at 2.00% for overall acceptability. Similarly for colour and body & texture, it is possible to recommend yoghurt spread with mint and for flavour chilli at 1.00% salt concentration level respectively. These results clearly indicated that application of different condiments and salt concentration played an important role in improving the eating quality attributes of the product significantly.

Table 1. Effect of salt concentration and condiments on proximate composition of yoghurt spread

Parameters	Treatment (Salt %)	Chilli	Curry Leaf	Mint	Aggregate
		Mean \pm SE	Mean \pm SE	Mean \pm SE	Mean \pm SE
Total Solids (%)	1.00	24.39 \pm 1.38 ^{bc}	24.44 \pm 2.41 ^{bc}	26.92 \pm 2.42 ^{ab}	25.25 \pm 1.14A
	1.25	24.37 \pm 0.36 ^{bc}	23.58 \pm 1.58 ^c	27.36 \pm 1.58 ^{ab}	25.10 \pm 0.87A
	1.50	24.91 \pm 1.28 ^{abc}	24.45 \pm 1.52 ^{bc}	27.47 \pm 1.04 ^a	25.61 \pm 0.80A
	2.00	25.14 \pm 0.79 ^{abc}	25.19 \pm 1.16 ^{abc}	27.03 \pm 1.67 ^{ab}	25.79 \pm 0.70A
	Aggregate	24.70 \pm 0.45B	24.41 \pm 0.76B	27.20 \pm 0.75A	25.44 \pm 0.43
Moisture (%)	1.00	75.61 \pm 1.38	75.56 \pm 2.41	73.08 \pm 2.42	74.75 \pm 1.14
	1.25	75.63 \pm 0.36	76.42 \pm 1.58	72.64 \pm 1.58	74.90 \pm 0.87
	1.50	75.09 \pm 1.28	75.55 \pm 1.52	72.53 \pm 1.04	74.39 \pm 0.80
	2.00	74.86 \pm 0.79	74.81 \pm 1.16	72.97 \pm 1.67	74.21 \pm 0.70
	Aggregate	75.30 \pm 0.45A	75.59 \pm 0.76A	72.80 \pm 0.75B	74.56 \pm 0.43
Protein (%)	1.00	8.36 \pm 0.40	9.01 \pm 1.08	9.52 \pm 0.91	8.96 \pm 0.45
	1.25	8.57 \pm 0.10	8.74 \pm 0.90	10.74 \pm 0.69	9.35 \pm 0.48
	1.50	8.46 \pm 0.43	9.09 \pm 0.93	10.31 \pm 0.92	9.29 \pm 0.48
	2.00	8.31 \pm 0.43	9.06 \pm 0.37	9.07 \pm 0.70	8.82 \pm 0.29
	Aggregate	8.43 \pm 0.16A	8.98 \pm 0.37A	9.91 \pm 0.40B	9.10 \pm 0.21
Fat (%)	1.00	10.63 \pm 1.15	8.52 \pm 0.69	8.96 \pm 1.55	9.37 \pm 0.67
	1.25	10.82 \pm 0.40	8.95 \pm 1.18	10.64 \pm 0.91	10.1 \pm 0.54
	1.50	11.50 \pm 2.14	7.84 \pm 0.52	9.83 \pm 0.57	9.72 \pm 0.84
	2.00	10.03 \pm 0.54	9.13 \pm 0.90	9.36 \pm 1.38	9.51 \pm 0.52
	Aggregate	10.74 \pm 0.56A	8.61 \pm 0.39B	9.70 \pm 0.53C	9.68 \pm 0.32
Ash (%)	1.00	1.58 \pm 0.10	1.56 \pm 0.15	1.62 \pm 0.16	1.59 \pm 0.07A
	1.25	1.46 \pm 0.07	1.85 \pm 0.24	2.01 \pm 0.11	1.77 \pm 0.11A
	1.50	2.04 \pm 0.12	2.09 \pm 0.11	2.19 \pm 0.14	2.10 \pm 0.07B
	2.00	2.53 \pm 0.06	2.64 \pm 0.07	2.33 \pm 0.20	2.50 \pm 0.08B
	Aggregate	1.90 \pm 0.13	2.03 \pm 0.14	2.04 \pm 0.10	1.99 \pm 0.07

Levels not connected by same letter are significantly different.

Table 2. Effect of salt concentration and condiments on total viable count of yoghurt spread

Condiments	1.00% Level	1.25 % level	1.50% Level	2.00% level
Chilli	8.597	8.130	7.985	7.836
Curry Leaf	8.006	7.137	7.029	6.716
Mint	7.749	7.213	6.749	6.501

Log₁₀ cfu/ml (n=3)

Table 3. Effect of salt concentration and condiments on sensory characteristics of yoghurt spread

Characters	Treatment (Salt Concentration in percent)	Chilli	Curry Leaf	Mint	Aggregate
		Mean \pm SE	Mean \pm SE	Mean \pm SE	Mean \pm SE
Appearance	1.00	6.89 \pm 0.14 ^{ab}	7.19 \pm 0.28 ^a	6.67 \pm 0.18 ^{ab}	6.91 \pm 0.12
	1.25	6.70 \pm 0.18 ^{ab}	6.89 \pm 0.30 ^{ab}	6.56 \pm 0.27 ^b	6.72 \pm 0.15
	1.50	6.70 \pm 0.16 ^{ab}	7.22 \pm 0.22 ^a	6.56 \pm 0.23 ^b	6.83 \pm 0.12
	2.00	6.93 \pm 0.11 ^{ab}	6.93 \pm 0.26 ^{ab}	6.33 \pm 0.18 ^b	6.73 \pm 0.11
	Aggregate	6.81 \pm 0.07 ^{AB}	7.06 \pm 0.13 ^A	6.53 \pm 0.11 ^B	6.80 \pm 0.06
Colour	1.00	7.11 \pm 0.18 ^{ab}	6.74 \pm 0.25 ^{abc}	7.22 \pm 0.13 ^a	7.02 \pm 0.11
	1.25	6.93 \pm 0.17 ^{abc}	6.96 \pm 0.27 ^{abc}	7.07 \pm 0.12 ^{ab}	6.99 \pm 0.11
	1.50	6.93 \pm 0.19 ^{abc}	7.15 \pm 0.28 ^{ab}	6.96 \pm 0.15 ^{abc}	7.01 \pm 0.12
	2.00	7.07 \pm 0.17 ^{ab}	6.48 \pm 0.23 ^c	6.67 \pm 0.14 ^{bc}	6.74 \pm 0.11
	Aggregate	7.01 \pm 0.09 ^A	6.83 \pm 0.13 ^A	6.98 \pm 0.07 ^A	6.94 \pm 0.06
Body & Texture	1.00	6.70 \pm 0.22 ^{cd}	6.96 \pm 0.21 ^{abcd}	7.48 \pm 0.11 ^a	7.05 \pm 0.11
	1.25	6.67 \pm 0.23 ^{cd}	6.81 \pm 0.23 ^{bcd}	7.26 \pm 0.13 ^{ab}	6.91 \pm 0.12
	1.50	6.74 \pm 0.16 ^{bcd}	7.04 \pm 0.23 ^{abc}	6.63 \pm 0.17 ^{cd}	6.80 \pm 0.11
	2.00	6.48 \pm 0.19 ^d	7.41 \pm 0.23 ^a	7.11 \pm 0.17 ^{abc}	7.00 \pm 0.12
	Aggregate	6.65 \pm 0.10 ^B	7.06 \pm 0.11 ^A	7.12 \pm 0.08 ^A	6.94 \pm 0.06
Flavour	1.00	7.37 \pm 0.17 ^a	6.70 \pm 0.16 ^{bc}	6.56 \pm 0.27 ^{bcd}	6.88 \pm 0.12
	1.25	6.85 \pm 0.23 ^{abc}	6.52 \pm 0.21 ^{bcd}	6.04 \pm 0.30 ^{de}	6.47 \pm 0.15
	1.50	6.81 \pm 0.19 ^{abc}	6.85 \pm 0.22 ^{abc}	5.78 \pm 0.27 ^e	6.48 \pm 0.14
	2.00	6.37 \pm 0.21 ^{bode}	6.89 \pm 0.13 ^{ab}	6.22 \pm 0.29 ^{cde}	6.49 \pm 0.13
	Aggregate	6.85 \pm 0.11 ^A	6.74 \pm 0.09 ^A	6.15 \pm 0.14 ^B	6.58 \pm 0.07
Taste	1.00	6.89 \pm 0.28 ^{ab}	6.04 \pm 0.27 ^{cd}	6.85 \pm 0.15 ^{ab}	6.59 \pm 0.14 ^A
	1.25	7.11 \pm 0.23 ^a	6.44 \pm 0.26 ^{bc}	6.41 \pm 0.15 ^{bcd}	6.65 \pm 0.13 ^A
	1.50	6.89 \pm 0.18 ^{ab}	7.15 \pm 0.17 ^a	6.44 \pm 0.15 ^{bc}	6.83 \pm 0.10 ^A
	2.00	5.81 \pm 0.34 ^d	6.56 \pm 0.21 ^{abc}	6.19 \pm 0.16 ^{cd}	6.19 \pm 0.14 ^B
	Aggregate	6.68 \pm 0.14 ^A	6.55 \pm 0.12 ^A	6.47 \pm 0.08 ^A	6.56 \pm 0.07
Overall Acceptability	1.00	7.15 \pm 0.17 ^{ab}	6.85 \pm 0.20 ^{abc}	6.89 \pm 0.18 ^{abc}	6.96 \pm 0.11
	1.25	6.85 \pm 0.22 ^{abc}	6.70 \pm 0.22 ^{abc}	6.81 \pm 0.19 ^{abc}	6.79 \pm 0.12
	1.50	6.78 \pm 0.20 ^{abc}	7.00 \pm 0.21 ^{abc}	6.56 \pm 0.15 ^c	6.78 \pm 0.11
	2.00	6.56 \pm 0.17 ^c	7.19 \pm 0.16 ^a	6.63 \pm 0.14 ^{bc}	6.79 \pm 0.10
	Aggregate	6.83 \pm 0.10 ^A	6.94 \pm 0.10 ^A	6.72 \pm 0.08 ^A	6.83 \pm 0.05

Levels not connected by same letter are significantly different.



(A)



B

Fig 1. Yoghurt spread (A) and Samples spread on bread for taste panel evaluation (B)

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