EFFECT OF INCORPORATION OF CONDENSED CHEESE WHEY AND
Bifidobacterium bifidum IN YOGURT

By

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THESIS
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CERTIFICATE

We, the undersigned members of the Advisory Committee of Mr. Mirza Ismail Baig, a candidate for the degree of Doctor of Philosophy in Dairy Science, have examined the thesis entitled "Effect of Incorporation of Condensed Cheese Whey and Bifidobacterium bifidum in Yogurt" and certify that the work done independently by Mr. Mirza Ismail Baig, under my guidance and supervision, is a record of research work done for the award of any degree, fellowship or associateship to him.

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ABSTRACT

An experiment was conducted to assess the possibility of utilization of whey solids in different forms in yogurt as a substitute for NDM and also *P. bifidum* as an adjunct with the view to improve the therapeutic value of yogurt.

A detailed review of literature was presented on the morphological and physiological characteristics of starter cultures, importance and utilization of whey solids, effect of long term storage on starter bacteria and other related aspects.

Methodology of condensation of cottage cheese whey, preparation of whey protein dispersion, and manufacture of set and frozen yogurt has been described. Important analytical procedures were presented.

The experiment comprised of part A and part B based on the starter culture. The mix under the part A were fermented with conventional yogurt starter culture viz. *S. salivarius*; subsp. *thermophilus* and *L. delbrueckii* subsp. *bulgaricus*; as against this the mix under part B were fermented with combination of conventional yogurt starter and *B. bifidum*.

Each part comprised of four treatments based on types of milk solids used to raise the content of SNF to 13 per
For mixes under A-I and B-I fortification was with NDM. For A-II and B-II, condensed whey was used to replace 50 per cent NDM. Mixes under A-III and B-III were fortified with condensed whey to replace 100 per cent NDM; and whey protein dispersion was used to replace complete NDM under A-IV and B-IV.

The results obtained had been compared with similar reported studies and conclusions were drawn.

The data regarding the starter bacterial count indicated the optimum growth of thermophilus, bulgaricus and bifidobacteria in yogurt fortified with different forms of whey solids. The count of thermophilus and bifidobacteria were higher with the fortification of whey solids in yogurt mix; and the growth of bulgaricus was not adversely affected in the presence of the whey solids.

Incorporation of B. bifidum stimulated the growth of thermophilus, however, it was found to have some inhibitory effect on bulgaricus count. The inhibitory effect of B. bifidum on bulgaricus was lesser in presence of whey solids than in yogurt fortified with NDM.

Optimum growth of B. bifidum was obtained when grown in association with conventional yogurt culture.
The viable starter bacterial count was decreased by about one logarithmic unit during the process of freezing and hardening of yogurt at -20°C. Additional reduction by one to two logarithmic units was also recorded during the frozen storage for 90 days. At the end of 90 days of storage the population of viable starter bacteria, however, were higher than the minimum recommended range of $10^6$-$10^7$, so as to provide the nutritional and therapeutic benefits after consumption.

Coliform count in the set yogurt was in the range of 1.66-5.00 cfu per ml. Yeast and mould count were 3.33-11.66 cfu per ml.

Optimum acidity was produced in yogurt fortified with different forms of whey solids and also in presence of B. bifidum. The titratable acidity was in the range of 0.93-1.02 in set yogurt at pH 4.6. No appreciable change in titratable acidity and pH was observed during the storage of frozen yogurt.

The content of NPN in set yogurt under different treatments were 46.69-63.03 mg per 100 g. The tyrosine values were in the range of 0.17-0.24 mg per g. There was a gradual increase in tyrosine value during the storage of frozen yogurt for 90 days at -20°C.
The content of the diacetyl and acetaldehyde in the set yogurt were 7.83-19.00 ppm and 31.50-43.04 ppm respectively. The yogurt fortified with whey protein dispersion contained highest concentration of diacetyl. The concentration acetaldehyde in yogurt fortified with condensed whey as a substitute for complete NDM was significantly higher in comparison to products under other treatments.

Incorporation of *B. bifidum* as a supplementary culture reduced the levels of both diacetyl and acetaldehyde in set yogurt.

The contents of acetic acid in set yogurt under the treatments of part B were 0.08-0.21 per cent and no acetic acid were detected in treatments under part B.

Organoleptic evaluation indicated that the fortification of whey solids did not affected the flavour and textural characteristics in set and frozen yogurt. On the contrary the flavour, body and texture scores of set yogurt were improved by incorporation of whey protein dispersion.

After 90 days of storage the organoleptic characteristics of the frozen yogurt has not changed appreciably.
It can be concluded that a good quality set and frozen yogurt can be prepared with substitution of NDM by different forms whey of solids. Amongst the different forms of whey solids, the whey protein dispersion was found to be best. From the present study it is also proved that the vacuum condensation can be one of the viable method for recovering whey solids from the byproducts of cottage cheese.

Yogurt can be a best vehicle for incorporation of bifidobacteria in a dietary adjunct. Long time storage of frozen yogurt has not affected the microbiological in textural quality of frozen yogurt. After the 90 days of storage of frozen yogurt at -20°C, sufficient starter bacteria are present to have their beneficial therapeutic effect after consumption.

Further studies on utilization of whey solids in indigenous dairy products may help in improving the nutritive value, and reducing the whey disposal problems.

Studies on amino acids profile of yogurt fortified with whey solids and supplemented with bifidobacteria may also prove beneficial in better understanding the growth requirements and symbiotic relationship between starter bacteria.