UTILIZATION OF LESSER YAM (DISCOREA ESCULANTA LOUR) BURK POWDER AS STABILIZER IN PANEER MAKING


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ABSTRACT

Utilization of lesser yam (dioscorea esculenta (lour) burk) powder as paneer stabilizers is studied to find its suitability on commercial level. It was observed moisture retention, fat, FDM and acidity showed rising trend with increase in the level of stabilizer but the total solids content decreased with increased in the level of stabilizer. The differences in sensory score for these quality attributes due to different treatments were highly significant (P<0.05). The use of stabilizers in paneer making resulted in reduction in the cost of paneer production.

Key words : Lesser yam, Stabilizer, Paneer, Discorea esculanta lour.

INTRODUCTION

Paneer, an acid coagulated milk product was first introduced in India by the Persian and Afigan invaders. Paneer provides an excellent method of conserving and preserving precious milk solids in highly concentrated form. There is good scope for paneer production in India. Use of stabilizers has been practiced by food industry for long to improve the functional characteristics of foods. In paneer making, hydrocolloids (stabilizers) are used due to its inherent qualities. The water binding capacity, consistency, yield and total solids recovery of paneer can be improved by the addition of sodium alginate, canageenan, pregelatinised potato starch and CMC (Sachdeva and Singh, 1988). There is a growing trend to use natural hydrocolloids particularly of plant origin due to religious taboos, easy availability, cheapness, nutrition, nontoxicity in gums and it saves foreign exchange. Kangar (Dioscorea esculenta (Lour) Burk) powder appears to have better hydrocolloidal properties. Kangar commonly called as Lesser yam or Chinese yam is a rich source of non-fat solids. D. esculenta and D. bulbifera are the commonly grown species in Konkan regions. It contains good amount of pectin or mucilage, which renders binding quality of paneer. The information on utility of Kangar powder or lesser yam powder as paneer stabilizers is lacking. Hence, the present investigation was undertaken to explore the possibility of using this stabilizer in paneer making.

MATERIALS AND METHODS

The present investigation on Lesser yam powder as paneer stabilizers was carried out at the Department of Animal Husbandry and Dairy Science, College of Agriculture, Dapoli, Dist. Ratnagiri, Maharashtra. The milk was procured immediately after morning milking. The fresh yam tubers were washed thoroughly to remove off the dirt, peeled off and sliced into thin chips. The chips were washed with water to remove stickiness and treated with 0.1 per cent potassium metabisulphate solution for two hours to retain colour and avoid spoilage. The chips were put into boiling water for about 10 minutes. The water was drained out and the chips were sun dried for 6 hours. Final drying was done in a cabinet drier (60°C). These dried chips were ground into powder and sieved through 60-mesh sieve to obtain a very fine powder suitable for use in paneer making. Paneer was manufactured as per the procedure standardized by Sachdeva et al.,

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Kangar powder was added to cow milk while heating, but before coagulation at 90°C temperature in the following proportions:

- $T_0L_0$ - Control (No stabilizer)
- $T_1L_1$ - Lesser yam powder at 0.15 per cent level
- $T_1L_2$ - Lesser yam powder at 0.30 per cent level
- $T_1L_3$ - Lesser yam powder at 0.45 per cent level

These treatments were replicated eight times. The above combinations were treated as four treatments. The representative samples of milk, paneer and whey were subjected to chemical analysis. Milk was analyzed for fat, total solids, acidity and protein. Paneer was analyzed for yield, fat, total solids, acidity, moisture and protein. The whey was also analyzed for fat, total solids and protein. The fat content and total solids of milk and whey was determined by using standard Gerber method as described IS:1479 (Part-II) 1961. The acidity of milk and whey was determined according to IS: 1479 (Part -II) 1961. The protein content of milk and whey was determined by the method given by Chaudhari (1959). The titratable acidity, fat, protein and moisture content of paneer were determined by the method given by Chaudhari (1959). The paneer was evaluated organoleptically for various quality attributes such as flavour, body and texture and colour and appearance by a panel consisting of 5 judges. A scorecard was prepared on the basis of a 9-point hedonic scale described by Amerine et al. (1965). The paneer was also evaluated in raw and fried form.

**Statistical Analysis:** The result obtained during course of investigation was subjected to statistical analysis by using randomized block design (Snedecor and Cochran, 1967). The sensory score of various quality attributes of paneer of different treatments were compared statistically to test the significance of difference by Kramer’s Rank Sum Test.

**RESULT AND DISCUSSION**

**Effect of utilization of lesser yam (Discorea esculenta lour) burk powder on chemical composition of paneer and its yield:** The average chemical composition of the paneer made using different type and levels of stabilizers is delineated in Table 1.

It is evident from the data that, the moisture content of paneer ranged from 52.31 per cent ($T_0L_0$) to 56.23 per cent ($T_1L_3$). The differences in moisture content of paneer due to different treatments were statistically significant ($P<0.05$). Among the treatment tried, $T_1L_3$ exhibited higher moisture content than others. Further, the moisture retention was found to be in increasing order with increase in the level of stabilizers. It is evident from the result that all the treated paneer exhibited higher moisture content compared to that of control ($T_0L_0$) paneer. This is due to the complex network of stabilizer/hydrocolloids used in the present investigation. Sachdeva and Singh (1988) reported increase in the moisture retention and yield of paneer where hydrocolloids were used such as CMC, sodium alginate, carrageenan and starch with different levels. Roy and Singh (1994) who also reported increase the moisture retention and yield of paneer where hydrocolloids used.

It would be seen from the Table 1 that the fat content in paneer varied from 24.85 per cent ($T_0L_0$) to 25.35 per cent ($T_1L_3$). Differences in fat content of paneer due to different treatments were statistically significant. Among the treatments tried, $T_1L_3$ exhibited significantly higher fat content than all other treatments under study. The paneer of control ($T_0L_0$) group showed significantly ($p < 0.05$) lower fat content than all other treatments. The fat content in paneer was increased with increasing level of stabilizers. The moisture and fat content of the paneer is influenced by several factors such as composition of milk and temperature of coagulation (De et al., 1971; Chawla et al., 1985; Sachdeva et al., 1985; Singh and Kanawjia, 1988; Bhattacharya et al., 1971; Sachdev and Singh (1988), Singh and Kanawjia, (1991); Roy and Singh, 1994), hydrocolloids and stabilizers due to water binding capacity of hydrocolloids/stabilizers, a complex network in the system of paneer making is fanned and thereby during the coagulation the fat gets entrapped into the complex and probably this could be the reason for higher fat content in the treated paneer than the control ($T_0L_0$). The average values of fat content in paneer on dry matter basis in different treatments are furnished in Table 1. Fat content on dry matter basis of paneer varied from...
Differences in fat content on dry matter basis were significant at P<0.05 level. With increasing levels of stabilizers, fat content on dry matter basis in paneer also increased. FDM has got direct positive correlation with fat content and moisture content of paneer, hence rise in the fat and moisture content in the paneer prepared from cow milk with stabilizer also reflected in increase FDM content of the paneer. In the present investigation, the cow milk contained 4.65 per cent fat resulting into paneer with fat content of more than 50 per cent (DM basis). Bhattacharya et al., (1971) and Vishweshwaraiah and Anantakrishnan (1986) reported that a level of more than 4.5 per cent fat in milk is essential to yield product with FDM more than 50 per cent.

The protein content of paneer in respect of all the treatments were observed well within the limits as prescribed by PFA standards. However, differences in protein content of paneer did not vary significantly due to different treatments. Protein content varied from 17.44 (T0L0) to 17.87 (T1L3). The results of present study matches well with the results obtained by Singh and Kanawjia (1988) who reported that there was no specific trend in protein content of paneer in response to added calcium chloride as additive at different levels. Sachdeva and Singh (1988) found increase in protein content in paneer with the decrease in milk fat content. Buchanan et al., (1965) observed 96 per cent recovery of casein and protein in skim milk with heating at 90°C and addition of 0.24 per cent CaCl₂ to precipitate proteins.

The data in respect of total solids content of paneer of different treatments are presented in Table 1. The lowest content of total solids 43.78 per cent (T1L3) was observed in paneer prepared from cow milk treated with 0.45 per cent lesser yarn powder, whereas the highest value of 47.69 per cent (T0L0) was recorded for control group. The variation in total solids content due to different treatments was significant (p<0.05). The total solids content in paneer was found to be in the descending order with increase in the level of stabilizers. Compared to control group (T0L0) decrease in the total solids content in paneer of stabilizer with different levels could be attributed to more moisture retention in control group. This is also evident from the whey analysis that loss of milk ingredient other than fat and protein was found to be increasing order with

Table 1. Average composition of the paneer made using different type and levels of stabilizers.

<table>
<thead>
<tr>
<th>Replication/ Treatment</th>
<th>Parameter</th>
<th>Control T0L0</th>
<th>0.15% T1L1</th>
<th>0.30% T1L2</th>
<th>0.45% T1L3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Moisture</td>
<td>52.31a</td>
<td>54.80b</td>
<td>54.98bc</td>
<td>56.23c</td>
</tr>
<tr>
<td>2</td>
<td>Fat</td>
<td>24.85a</td>
<td>24.93a</td>
<td>25.14ab</td>
<td>25.35bc</td>
</tr>
<tr>
<td>3</td>
<td>Fat (DMB)</td>
<td>51.98a</td>
<td>55.70b</td>
<td>56.94c</td>
<td>58.19d</td>
</tr>
<tr>
<td>4</td>
<td>Protein</td>
<td>17.44</td>
<td>17.49</td>
<td>17.67</td>
<td>17.87</td>
</tr>
<tr>
<td>5</td>
<td>TS</td>
<td>47.69c</td>
<td>45.65c</td>
<td>44.97c</td>
<td>43.78a</td>
</tr>
<tr>
<td>6</td>
<td>Titratable acidity</td>
<td>0.29a</td>
<td>0.31ab</td>
<td>0.32b</td>
<td>0.33b</td>
</tr>
<tr>
<td>7</td>
<td>Yield</td>
<td>12.87a</td>
<td>14.30b</td>
<td>14.88bc</td>
<td>15.40bc</td>
</tr>
</tbody>
</table>

Values are average of 8 replication
Figures with common superscript indicate that the treatment differences are non-significant

Table 2. Average composition of the whey obtained from paneer made using different levels of stabilizer.

<table>
<thead>
<tr>
<th>Replication/ Treatment</th>
<th>Parameter</th>
<th>Control T0L0</th>
<th>0.15% T1L1</th>
<th>0.30% T1L2</th>
<th>0.45% T1L3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fat</td>
<td>0.52bc</td>
<td>0.55bc</td>
<td>0.53bc</td>
<td>0.49b</td>
</tr>
<tr>
<td>2</td>
<td>Protein</td>
<td>0.44</td>
<td>0.44</td>
<td>0.42</td>
<td>0.44</td>
</tr>
<tr>
<td>3</td>
<td>TS</td>
<td>5.51a</td>
<td>5.69bc</td>
<td>5.93ab</td>
<td>6.22b</td>
</tr>
</tbody>
</table>

Values are average of 8 replication
Figures with common superscript indicate that the treatment differences are non-significant
the rising level of addition of the stabilizers. Bhattacharya et al. (1971) reported 47.08 per cent recovery of total solids in paneer prepared from skim milk having total solids content of 9.33 per cent whereas maximum recovery of 60.81 per cent was obtained with buffalo milk having total solids content of 15.33 per cent. Sachdeva and Singh (1988) mentioned that total solids recovery in paneer increased with increase in temperature of coagulation and maximum at 90°C. The results given in Table 1 show that there was significant variation in acidity of paneer due to different treatments. Acidity content varied from 0.29 per cent (T0L0) to 0.33 per cent (T1L3). Different levels of stabilizer had same level of acidity of paneer and it ranged from 0.31 to 0.33 percent showing increasing trend with increase in stabilizer level. The hydrocolloids have various functions in milk such as stabilization of the system, prevention of coagulation, due to these reasons, titratable acidity was found to be increasing order with increase in the level of stabilizers. Bhattacharya et al., (1971) and Rao et al., (1984) reported higher values of titratable acidity (0.47 to 0.50 per cent) for paneer prepared from cow and buffalo milk. They further stated that the variation in acidity values reported by different workers might be due to variation in analytical method.

The result pertaining to recovery of paneer is furnished in Table 1. The average value of yield of the paneer in control group without stabilizers (T0L0) was significantly (p < 0.05) lower than the paneer yield of all treated group with different levels of stabilizers. Yield of paneer varied from 12.87 per cent (T0L0) to 15.40 per cent (T1L3).

Comparison of paneer yield at different levels of lesser yam powder stabilizer showed that the treatment T1L3 was superior to treatment T1L1 but was at par with T1L2. Further, it was noticed that the paneer recovery improved with the increase in the level of stabilizer. Higher yield of paneer in stabilizer-incorporated treatment was due to maximum protein coagulation in such treated milk and greater entrapment of fat in coagulum as is evident from the analysis of paneer on dry matter basis in Table 1. The yield of paneer is significantly influenced by composition of milk (Bhattacharya et al., 1971; Chawla et al., 1985 Sachdeva et al., 1985; Singh and Kanwia, 1988; temperature of coagulation (Rao et al., 1984; Roy and Singh, 1994) and type of coagulant and additives etc. The hydrocolloids are well known for their moisture binding ability. In the present investigation, yield of paneer showed proportionate increase with moisture retention of different types of paneer prepared with various levels of stabilizers. Similar reports were reported by Sachdeva and Singh (1988), they stated that the binding capacity and yield of paneer can be improved by the sodium alginate (0.1%), Carrageenan (0.15 per cent), pre-gelatinized potato starch (0.15 per cent) and CMC (0.1%). Roy and Singh (1994) also reported increase in the moisture retention and yield of paneer where hydrocolloids were used. Sachdeva and Singh (1995) observed higher paneer yield by coagulation at 90°C with addition of stabilizers (sodium alginate 0.1 per cent and pre-gelatinized potato starch 0.15%).

**Chemical composition of whey:** The chemical composition of paneer whey is delineated in table 2. It could be seen from the content of table that there was significant variation in fat content of whey due to various treatments. In general, milk fat loss through whey during the process of paneer making was more in control than the treated samples. Among lesser yam group, differences between 0.15 per cent and 0.30 per cent level and 0.30 per cent and 0.45 per cent level were non-significant. Further T1L3 had

**Table 3. Sensory evaluation of mean score values for different quality attributes of paneer of different treatments.**

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Flavor</th>
<th>Body and texture</th>
<th>Colour and appearance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Raw</td>
<td>Fried</td>
<td>Raw</td>
</tr>
<tr>
<td>Control - cow milk (T0L0)</td>
<td>7.6</td>
<td>7.9</td>
<td>8.0</td>
</tr>
<tr>
<td>0.15% Kangar powder (T1L1)</td>
<td>7.5</td>
<td>8.0</td>
<td>7.7</td>
</tr>
<tr>
<td>0.30 % Kangar powder (T1L2)</td>
<td>7.7</td>
<td>8.2</td>
<td>8.3</td>
</tr>
<tr>
<td>0.45% Kangar powder (T1L3)</td>
<td>7.3</td>
<td>7.9</td>
<td>7.6</td>
</tr>
</tbody>
</table>

(Average mean score of 8 replications)
significantly lower fat loss through whey than \( T_{1L1} \). It was observed that the fat loss in whey reduced with increasing levels of the stabilizers.

The lower fat loss through whey during paneer preparation was due to more retention of fat with complex network developed due to stabilizers. Compared with the present observations higher fat loss of 0.80 to 1.00 per cent was reported by De et al. (1971) during paneer making from high acid milk, whereas Vishweshwaraiah and Anantakrishnan (1986) noticed lower fat loss of 0.12 per cent to 0.30 per cent in whey depending upon the fat level in milk used for paneer preparation. The protein content of paneer whey as influenced by different treatments is given in Table 2. The average protein content of whey is 0.44, 0.44, 0.44, and 0.44 per cent in \( T_{0L0} \), \( T_{1L1} \), \( T_{1L2} \), and \( T_{1L3} \), respectively. The variation in these values was however, non-significant, indicating that added stabilizers had no effect on loss of protein in whey during paneer preparation.

Sensory evaluation of paneer: The sensory evaluation of paneer was carried out by the panel of judges and the results with respect to flavour, body and texture and colour and appearance are presented in Table 3.

The data regarding mean score in respect of flavour showed that the highest ranking score 7.7 for raw paneer was obtained in case of \( T_{1L2} \). Whereas the lowest score of 7.3 was observed for \( T_{1L3} \). The statistical analysis showed highly significant (\( P<0.01 \)) difference in flavour score of different paneer. Similar were the results for fried paneer. The data regarding mean score in respect of body and texture given in Table 4 showed that raw paneer of \( T_{1L2} \) group received the highest score. The fried paneer of \( T_{1L3} \) group had the lowest score of 7.6. The score of this parameter obtained by different treatments was compared statistically. The raw and fried paneer of \( T_{1L3} \) (lesser yam powder at 0.30% level) was superior to Paneer of other treatments. It was noticed that the paneer of all the groups showed highly significant differences in body and texture quality. Similar to that of flavour and body texture qualities, the colour and appearance of the paneer of different treatments also showed highly significant differences (\( P<0.05 \)). The score for colour and appearance of raw paneer ranged from 7.7 in \( T_{0L0} \) to 7.9 in \( T_{1L2} \). Similarly that for friend paneer varied from 7.8 in \( T_{0L0} \) and 8.5 in \( T_{1L3} \). The raw paneer prepared with 0.30 per cent lesser yam excel1ed all other paneer in colour and appearance. The above results indicate that the paneer of different treatments was acceptable and was of good quality. However, the product prepared 0.30 per cent lesser yam was superior in quality compared to other treatments.

Table 4. Average cost of paneer production (based on cost of in gradients only) in different groups.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Quantity of Ingredients used</th>
<th>Quantity of Panee produced</th>
<th>Total cost of paneer (Rs./kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control - cow milk (( T_{0L0} ))</td>
<td>Milk (g) Kangar powder (g) Citric acid (mg)</td>
<td>715</td>
<td>128.6</td>
</tr>
<tr>
<td>0.15% Kangar powder (( T_{1L1} ))</td>
<td>1000 1.5 715</td>
<td>143.0 9.60- 67.13 4.01</td>
<td></td>
</tr>
<tr>
<td>0.30% Kangar powder (( T_{1L2} ))</td>
<td>1000 3.0 715</td>
<td>148.7 9.97 67.04 4.14</td>
<td></td>
</tr>
<tr>
<td>0.45% Kangar powder (( T_{1L3} ))</td>
<td>1000 4.5 715</td>
<td>157.0 0.90 69.42 0.73</td>
<td></td>
</tr>
</tbody>
</table>

* Cost of ingredients: 1) Milk Rs.9.0/lit. 2) Kangar powder Rs.25/kg, 3) Citric acid Rs.300/kg.
Coagulation at 90°C with stabilizers/hydrocolloids incorporated in milk results in higher yield and imparts better body and texture and consistency in the characteristic paneer. Due to the addition of stabilizers, the hard body and less yield was completely overcome. Whereas, Singh and Kanawjia (1988) reported that addition of CaCl2 to raw milk prior to coagulation at 85°C improved the sensory score of paneer. Singh et al., (1991) stated that addition of whey solids affected the sensory quality of both raw as well as fried paneer. Whereas, Mistry et al., (1972) observed significantly higher sensory score for flavour and body and texture with addition of salts like calcium sulphate and disodium hydrates phosphate.

**Economics of paneer production:** One of the main objectives of the present investigation was to study the possibility of reducing the cost of paneer by using stabilizer (lesser yam at the level of 0.15%, 0.30%, 0.45%). Hence, cost economics of paneer production was worked out considering the prevailing retail costs of ingredients. The cost structure of paneer production is illustrated in Table 4.

It would be seen that the highest cost of Rs.69.93/kg paneer was recorded in case of paneer prepared without stabilizer (T0L0). The treatments with stabilizers of lesser yam powder at different levels showed lower cost compared to control. Different levels of lesser yam powder viz., T1L1 (0.15%), T2L2 (0.30%), T3L3 (0.45%) yielded one kg paneer at a cost of Rs.67.13, 67.04 and 69.42 respectively. Thus compared to control (T0L0) group cost reduction was in the magnitude of 4.01, 4.14 and 0.73 per cent at 0.15 per cent, 0.30 per cent, 0.45 per cent levels of lesser yam powder, respectively.

From the above data, it appears that there is no much change in the cost of paneer production.

**SUMMARY AND CONCLUSION**

An experiment was undertaken to study the effect of bhendi gum as stabilizers on the quality and composition of the paneer. The differences in respect of these chemical constituents were significant except for protein content. It was observed that due to use of stabilizers, moisture retention, fat, FDM and acidity were increased as compared to control group with no stabilizers. The yield of paneer in different treatments under study varied significantly. The paneer yield from T0L0 (without stabilizer) group produced significantly lower yield than other treatments. Within the particular stabilizer group, in general, positive con-elation was observed between yield and stabilizer level. Fat and total solids content of paneer whey differed significantly due to treatments but protein content in different paneer whey showed non-significant differences. The differences in sensory score for these quality attributes due to different treatments were highly significant (P<0.05). It was observed that the quality of paneer was good in all the treatments as the sensory score was above 7.0. The use of stabilizers in paneer making resulted in reduction in the cost of paneer production. The highest reduction of 4.14 per cent in the cost was noticed in T1L2 group as compared to control. Reduction in cost was possible due to increased yield of paneer due to use of stabilizers. From the results of the study, it is inferred that the use of lesser yam (*Discorea esculanta lour*) burk powder at 0.30 per cent level, yields the paneer of desirable quality at comparatively lower cost than paneer with no stabilizers.

**REFERENCES**