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Preparation of Low Fat *Lassi* by Incorporation of Ginger (*Zingiber officinale* L.) Juice

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ABSTRACT

The study was conducted at Dept. of Animal Husbandry and Dairy Science, Dr. BSKKV, Dapoli, Ratnagiri, Maharashtra, India during August 2010–January 2011 to evaluate the suitability of ginger juice as flavoring agent in developing ginger lassi. Lassi is a cultured milk beverage and a popular product in India, In Maharashtra also generally lassi is prepared from buffalo milk curd which gives creamy appearance with pleasant mildly acidic sweet taste and rich aroma. The functionality of Lassi increases with the addition of probiotic microorganisms and incorporation of antioxidant rich fruit juice provides strong antioxidant power endow with value addition to the finished product. Ginger is mostly used to cure nausea, ulcer, stroke, Sore throat, Hypertension, indigestion, and Arthritis. Ginger appears to be promising for safe use in medicine, pharmaceutical and food industries. Ginger is a popular home remedy in India today. Hence forth considering the medicinal properties of ginger and use of skim milk in restricting the caloric intake. The lassi was prepared from buffalo skim milk by using ginger juice at different levels viz. 1.5% (T_1), 3.0% (T_2), 4.5% (T_3) and 6.0% (T_4) of the content. This prepared lassi was compared with control lassi (T_0) i.e. without addition of ginger juice. Ginger juice could be successfully utilized for preparation of herbal lassi. The most acceptable quality lassi can be prepared by using 3.0% ginger juice and It recorded on an average total solid, fat, protein, ash, and acidity as 18.49, 0.52, 3.43, 0.78, and 0.79% respectively.

KEYWORDS: Buffalo skim milk, ginger juice, herbal, *lassi*, sensory

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Data Availability Statement: Legal restrictions are imposed on the public sharing of raw data. However, authors have full right to transfer or share the data in raw form upon request subject to either meeting the conditions of the original consents and the original research study. Further, access of data needs to meet whether the user complies with the ethical and legal obligations as data controllers to allow for secondary use of the data outside of the original study.

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1. INTRODUTION

India is the largest milk producing country in the world with its 209.96 mt milk production and 427 g person^{-1} daily milk consumption, enjoys number one position in terms of milk production (Anonymous, 2022). Out of the total milk produced, about 45 to 50% is converted into indigenous dairy products. On the other hand, only 9% of milk is converted into fermented type of milk products and this sector is showing an annual growth rate of more than 20% annum^{-1} (Singh, 2006). *Dahi*, the curd, obtained by lactic fermentation of milk is one of the components of "panchamritam" the pious drink in Hindu religion. Curd promotes the health of the host by boosting the immune system. It strengthens natural immunity by stimulation of mucosal and systemic host immunity, which is manifested through activated macrophages, increased levels of immunoglobulins, higher levels of natural killer (NK) cell activities and cytokines in the host body (Ashraf and Shah, 2014). So, curd can be used for the treatment of allergy, urinogenital infections, HIV, cancer, liver disease, inflammatory bowel disease (IBD), irritable bowel syndrome (IBS) and pancreatitis (Shadnoush et al., 2013). Therefore, it seems necessary to develop pro-health attitudes and beliefs that encourage consumption of these products within the framework of national nutritional guidelines, which may protect and help and contribute to reducing the incidence of chronic non-communicable diseases in various age groups of the population (Danielewicz et al., 2022).

Milk fat is composed of higher concentration of saturated fat and cholesterol to add the problems of calorie conscious people. Lassi is a cultured milk beverage and a popular product in India (Krishna et al., 2019.) In the northern region of the country, whole milk curd beaten up and served as a beverage. In Maharashtra also generally lassi is prepared from buffalo milk curd which gives creamy appearance with pleasant mildly acidic sweet taste and rich aroma (Mule et al., 2017). The functionality of Lassi increases with the addition of probiotic microorganisms and incorporation of antioxidant rich fruit juice provides strong antioxidant power endow with value addition to the finished product (Kumar and Kumar, 2016). The shelf life of lassi can be increased by heat treatment (Schulz, 1966), aseptic processing (Aneja et al., 2002), addition of preservatives (Hussain et al., 2014, Gupta and Prasad, 1989), different packaging materials (Patidar and Prajapati, 1998) and use of Humectants (Lacroix and Lachance, 1990). Pardhi et al. (2014), concluded that good quality, value added lassi with more acceptability be prepared by addition of finger millet flour.

Ginger is mostly used to cure nausea, ulcer, stroke, Sore throat, Hypertension, indigestion, and Arthritis (Sekiwa et al., 2000, Kumari et al., 2021a). Fresh ginger contains 80–85% moisture and it is susceptible to microbial growth and deterioration (Babu et al., 2013, Mishra et al., 2004) Ginger appears to be promising for safe use in medicine, pharmaceutical and food industries. Ginger is also often used in joint support supplements. Ginger was reported to have effectiveness for relieving joint pain of osteoarthritis (OA) and rheumatoid arthritis probably due to its anti-inflammatory effects (Thomson et al., 2002, Wigler et al., 2003, Ramadan et al., 2011). Extract of ginger powder is effective against several antifungal diseases. The principal antifungals in the ginger are the gingerols and ginger diol (Ramkissoon et al., 2012, Nasri et al., 2013). Ginger is a popular home remedy in India today.

Hence forth considering the medicinal properties of ginger and use of skim milk in restricting the caloric intake, the present research study was aimed to evaluate the suitability of ginger juice as flavoring agent in developing ginger lassi.

2. MATERIALS AND METHODS

2.1. Location and period of study

The present work was carried out at the Department of Animal Husbandry and Dairy Science, College of Agriculture, Dapoli (DR. BSKKV DAPOLI)- 415 712, Ratnagiri, Maharashtra, India during August 2010–January 2011.

2.2. Buffalo Skim milk

Buffalo milk collected from dairy farm of College of Agriculture, Dapoli and skim milk was obtained by centrifugal cream separation method was used for the study.

2.3. Starter culture

Local starter culture i.e., previous days good quality curd was used as culture. The starter culture selected for use was not having any defects in the curd produced from it

2.4. Ingredients

Cane sugar, salt and fresh ginger was purchased from local market.

2.5. Methodology

2.5.1. Extraction of ginger juice

Process flow chart for preparation of ginger extract (Patel et al., 2007) (Figure 1).

2.5.2. Lassi preparation

Lassi was prepared as per the procedure described by De (2008). with partial modification of mixing ginger juice (Figure 1).

2.5. Treatments

The experiment was conducted with five treatments with different concentration of ginger juice in preparation of

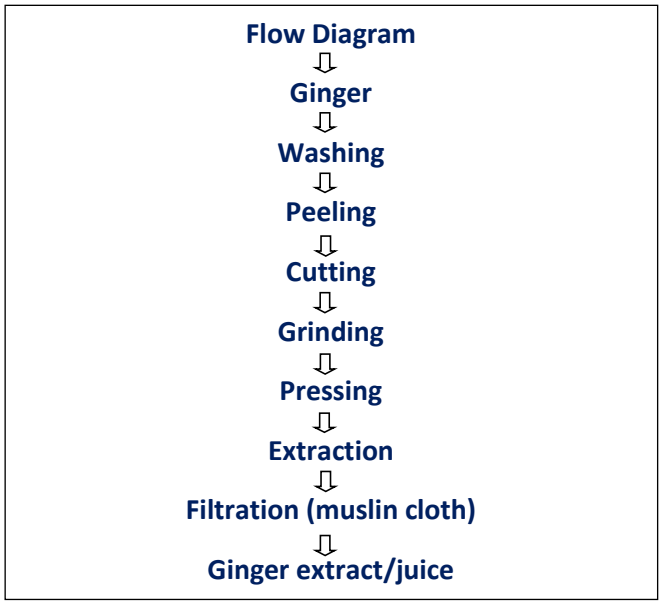

Figure 1: Process flow chart for Preparation of Ginger Extract

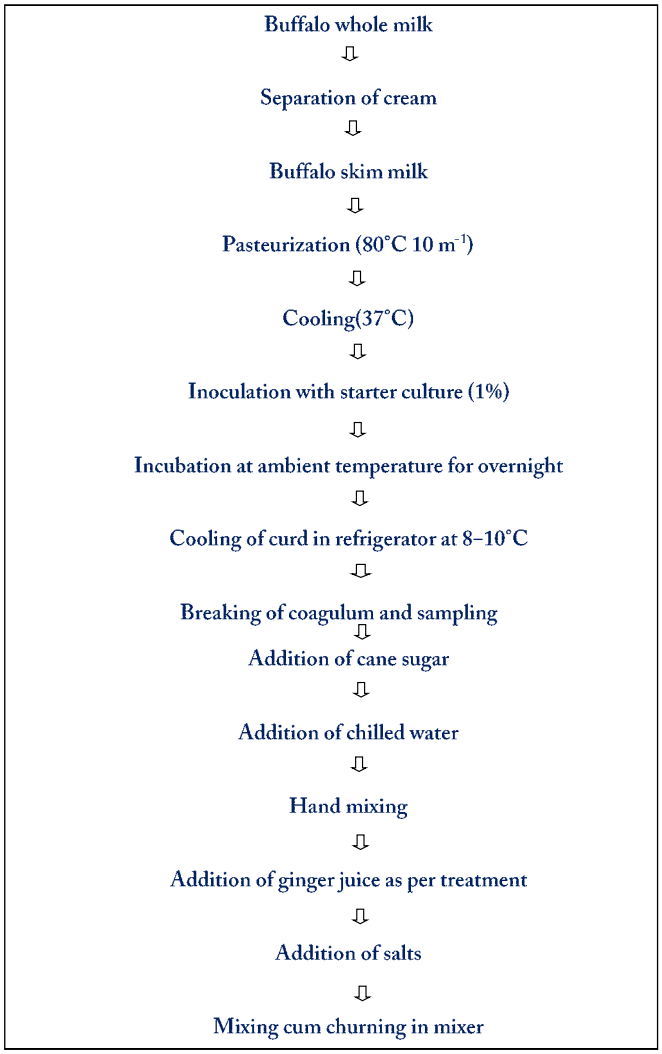

Figure 2: Flow chart for *lassi* preparation

lassi. The concentration of juice was kept as 0, 1.5, 3, 4.5 and 6% of curd (W/w) and termed as T_0, T_1, T_2, T_3 and T_4, respectively. The trial was conducted with six replications.

2.6. Analytical methods

2.6.1. Total solids

The total solids content was determined by Gravimetric method as per IS: 1479 (Part-II) (1961).

2.6.2. Fat

The fat content in *lassi* was determined by Gerber method as described in IS: 1224 (Part-I) (1977).

2.6.3. Protein

The protein was determined by estimating the per cent nitrogen by Micro-Kjeldhal method as recommend in IS: 1479 (Part- II) (1961). The per cent nitrogen was multiplied by 6.38 to find out the protein percentage in *lassi*.

2.6.4. Ash

The ash content was determined as per the method described in Anonymous (1975).

2.6.5. Titratable acidity

The acidity of *lassi* expressed as per cent lactic acid was determined according to IS: 1479 (Part-I) (1960).

2.7. Sensory evaluation of ginger lassi

The *lassi* was evaluated organoleptically for various quality attributes such as general appearance, body and texture (consistency) and flavour by a panel of ten judges. A score card as given below was prepared on the basis of 9 point Hedonic scale as described in IS: 6273 (Part- II) (1971).

2.8. Statistical analysis

For the present investigation Randomized Block Design was employed using five treatments and six replications. The data were tabulated and analyzed according to the statistical methods prescribed by Snedecor and Cochran (1994). The sensory score of *lassi* was compared statistically to test the significance of difference by Friedman's test of concordance as described in IS: 6273 (part III) (1983). The mathematical model used is as under:

$$\frac{12}{mn\,(n+1)} \sum_{i=1}^{n} Ri^2 - 3m\,(n+1) \qquad \text{.....(1)}$$

Where,

m=Number of panelists.

n=Number of samples.

Ri=Sum of ranks for i^{th} sample.

3. RESULTS AND DISCUSSION

The present investigation was undertaken to evaluate chemical and sensory quality of *lassi* by using different

level of ginger juice. The results of present research work are average of six-time replicated data tabulated, presented, and discussed along with Statistical analysis under following main heads.

3.1. Chemical analysis of ginger juice

The average chemical composition of ginger juice used in the present study is presented in Table 1.

Table 1: Average chemical analysis of ginger juice

Sl. No.	Constituents	Percentage
1.	Total solids	12.43
2.	Fat	1.2
3.	Protein	1.5
4.	Acidity	0.19

3.2. Chemical analysis of lassi

De (2008) stated that the composition of lassi varies considerably depending upon the composition of dahi, the extent to which the curd is diluted when churning and the efficiency of fat removal. Data pertinent to the total solids, fat, protein, ash and titratable acidity of lassi incorporated with levels of ginger juice are tabulated in Table 2 and illustrated in Figure 3.

3.2.1. Total solid

It was observed that the total solids content showed gradual decrease with the increase in level of ginger juice. This simultaneous decrease from T_0 to T_4 may be due to lower amount of total solids content in ginger juice. The lowest total solids content was noticed at T_4 i.e. (18.19%) with 6.0% ginger juice, while highest total solids content was observed at T_0 (18.72%) i.e. *lassi* prepared without ginger juice.

Table 2: Effect of different levels of ginger juice on chemical quality of *lassi*

Treatment	Chemical parameter (%)				
	Total solid	Fat	Protein	Ash	Titratable acidity
T_0	18.72	0.49	3.49	0.80	0.83
T_1	18.63	0.52	3.46	0.79	0.81
T_2	18.49	0.52	3.43	0.78	0.79
T_3	18.39	0.53	3.39	0.77	0.79
T_4	18.19	0.54	3.37	0.77	0.77
Mean	18.48	0.50	3.42	0.78	0.79
SEm±	0.010	0.005	0.010	0.005	0.007
CD (p=0.05)	0.029	0.013	0.028	0.016	0.022

** Significant at (p=0.01) level of significance

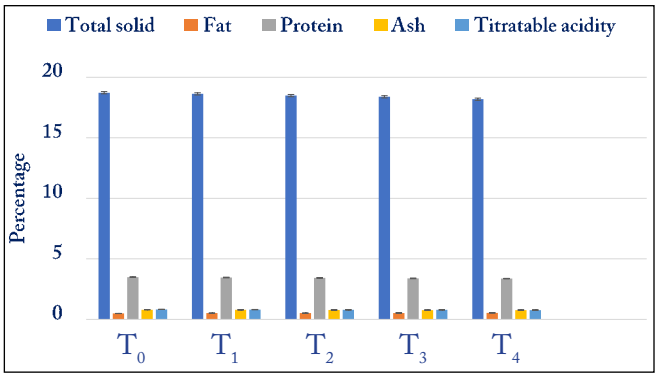

Figure 3: Effect of different level of ginger juice on Chemical quality *lassi*

From the table 2, it was observed that treatment difference is significant at 1% level of significance. The total solids content was significantly decreased with the increase in the level of ginger juice. Pardhi et al. (2015) reported Lassi preparing by adding finger millet @ 3% average total solid content 22.5%.

3.2.2. Fat

The perusal of data from table 2 revealed that the fat content in ginger lassi varied within the narrow range of 0.49 to 0.54%. This is due to very low amount of fat in plain skim milk lassi which was the major ingredient in all the treatment. The average fat content of lassi was 0.50%. The highest fat content in lassi (0.54%) was observed in T_4 i.e treatment with 6.0% ginger juice and lowest (0.49%) in treatment T_0.

It was observed that incorporation of ginger juice increased the fat content of lassi. This increasing trend of fat content can be attributed to the fact that ginger juice contained higher amount of fat than that of skim milk. Besides obvious reason is that as the level of ginger juice increased, there was reduction in the amount of plain lassi on added percentage basis. The lowest fat content in control may be due to fact that no fortifying agent (ginger juice) was added in the treatment. Pardhi et al. (2015) observes that Lassi preparing by adding finger millet @ 3% average fat content 2.8%.

From the table 2, it was observed that treatment difference is statistically significant at 1% level of significance, indicating that there was significant increase in fat content of lassi due to increase in level of ginger juice.

3.2.3. Protein

The perusal of data from Table 2 revealed that addition of ginger juice had significantly affected the protein content of lassi. Incorporation of ginger juice showed gradual decrease in protein content of lassi. This decrease can be attributed to the fact that as the level of ginger juice increased, there was reduction in amount of plain lassi on added percentage basis. Secondly due to very low protein content of ginger

juice (1.5%), its addition reduced the protein content of the final product.

The average protein content of lassi was 3.42%. The highest protein content in ginger lassi (3.49%) was observed in treatment T_0 i.e., lassi without ginger juice and the lowest (3.37%) at 6% of ginger juice (T_4).

From the Table 2 it was observed that treatment difference are statistically significant at 1% level of significance indicating that there was significant decrease in protein content of lassi due to increase in level of ginger juice. Pardhi et al. (2015) studied Lassi preparing by adding finger millet @ 3% average protein content 4.04%.

3.2.4. Ash

Table 2 revealed that the average ash content of ginger lassi was 0.78%. The ash content of lassi decreased with the increase in the level of ginger juice. Lowest ash content in lassi (0.77%) was observed at 4.5 and 6.0% level of ginger juice, respectively and the highest (0.80%) at control treatment (T_0).

The addition of ginger juice had significantly affected the ash content of lassi. It was observed that incorporation of ginger juice decreases the ash content of lassi. The obvious reason is that as the level of ginger juice increases, there was reduction in amount of plain lassi on added percentage basis.

From the Table 2, it was observed that treatment difference is statistically significant at 1% level of significance indicating that there was significant decrease in ash content of lassi due to increase in level of ginger juice.

3.2.5. Titratable acidity

The acidity showed declining trend with an increase in the level of ginger juice. The highest acidity level (0.83%) at treatment T_0 i.e lassi without addition of ginger juice while the lowest (0.77%) at treatment T_4 i.e., lassi with addition of 6.0% ginger juice.

The value of acidity of lassi were similar with the values recorded Upadhyay et al. (2017) as 0.86–1.04 for lassi by using carrot juice. The addition of ginger juice had significantly affected the acidity content of lassi. It was observed that incorporation of ginger juice decreases the acidity of lassi which may be due to low acidity of ginger juice (0.19%) as compared to curd (0.78%).

From Table 2, it was observed that treatment differences are statistically significant at 1% level of significance indicating that there was significant decrease in acidity content of lassi due to increase in the level of ginger juice.

3.3. Sensory evaluation of lassi

Sensory evaluation of any consumable product is the best method of judging the acceptability of the product by the consumers. The assessment was done by studying the characteristics like, General appearance, Flavour, and Consistency of the product by the panel of judges by using "Nine Point Hedonic Scale" score card. Each sample was bearing a code number so as to avoid its identity and have impartial results. The data pertaining to sensory score for general appearance, body and texture (consistency), flavor and overall acceptability at different treatment are given in Table 3 and illustrated in Figure 4.

3.4.1. General appearance

The perusal of data from Table 3 showed that the score for colour and appearance was increased upto T_2 i.e. 3.0% addition of ginger juice, thereafter score was declined simultaneously. The highest score (7.77) was obtained by the treatment T_2 i.e., *lassi* incorporated with 3.0% ginger juice. In colour and appearance scores very marginal and inconsistent changes were observed. All the samples scored were less than 7.77 as per hedonic scale. Very negligible differences were observed in between all the treatments. Addition of very small amount of ginger juice did not affect the change in colour and appearance was also very clean with homogenous, slightly thin consistency. Upadhyay et al. (2017) observe Score 7.02 to 8.3 for Colour and appearance in *lassi*.

Table 3: Effect of different levels of ginger juice on sensory characteristics of *lassi*

Treatment	Sensory parameter (Score out of nine)							
	General appearance		Body and texture (consistency)		Flavor		Overall acceptability	
	Average score	Rank	Average score	Rank	Average score	Rank	Average score	Rank
T_0	7.75	2	7.36	5	6.86	5	7.30	5
T_1	7.71	4	7.48	4	7.23	2	7.45	2
T_2	7.77	1	7.62	1	7.53	1	7.63	1
T_3	7.73	3	7.51	2	7.12	3	7.43	3
T_4	7.62	5	7.50	3	7.06	4	7.38	4
T: Cal	6.3		2.23		5.03		3.76	
Table value (p<0.05)	9.49		9.49		9.49		9.49	

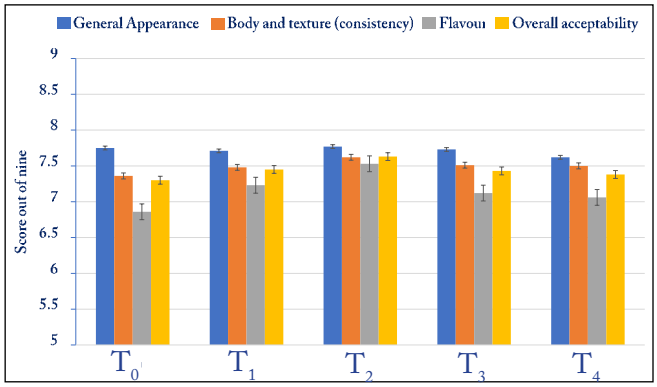

Figure 4: Effect of different level of ginger juice on sensory parameter of *lassi* (Nine-point hedonic scale)

3.4.2. Body and texture (consistency)

The perusal of data from Table 3 showed that, the lassi prepared with 3.0% level of ginger juice (T_2) recorded highest score for consistency (7.62) followed by T_3 (7.51). The descending order in score was observed like T_2, T_3, T_4, T_1 and T_0. Lowest score was observed at treatment T_0 i.e lassi without addition of ginger juice. Medium bodied lassi pouring similar to this gravy which seems most appropriate was observed at treatment T_2 i.e. lassi with 3.0% ginger juice. Upadhyay et al. (2017) observe similar Score 7.42-8.0 for Body and texture in *lassi*.

3.4.3. Flavour

The perusal of data from Table 3 showed that the lassi prepared with 3.0% ginger juice possessed highest score for flavor (7.53) as it was liked much by the judges which may be due to its sweet and typical acceptable ginger flavor. Further addition of ginger juice i.e. 4.5 and 6.0% disliked by the judges due to its deep pungent flavor. Next to treatment T_2, judges preferred lassi with 1.5% ginger juice i.e. T_1 as it possessed mild ginger flavor. Lowest score was observed for lassi at treatment control (T_0) with no ginger juice. Maji et al. (2020) reported that flavor for carrot lassi score 7.30-8.36.

3.4.4. Overall acceptability

The effect of different levels of ginger juice on overall acceptability of lassi is tabulated in Table 3 and Figure 4. For overall acceptability, average score obtained for colour and appearance, body and texture and flavour were considered. Upadhyay et al. (2017) observe overall acceptability Score 7.18-8.20.

From average figures of overall acceptability, lassi prepared from 3.0% ginger juice scored highest point (7.63), followed by 1.5% ginger juice lassi (7.45). The score was declined as 7.43,7.38 and 7.30 simultaneously at T_3, T_4 and T_0.

On basis of result obtained we can affirmatively state that amongst different levels of ginger juice, T_2 (3.0% ginger juice) treatment was found more acceptable by the judges i.e. good quality lassi was obtained with 3.0% ginger juice.

From the results of overall acceptability scores, thus indicates that lassi incorporated with 3.0% ginger juice is superior over rest of treatments. However, ginger juice @ 1.5% can produce good quality *lassi*. Higher level of ginger juice (4.5 and 6.0%) showed reduction in sensory quality score for lassi.

3.6. Standardization of method of addition of ginger juice for lassi preparation

The juice from the ginger rhizomes was extracted as discussed earlier. This juice was added to the lassi after churning of curd and addition of sugar. The sensory score revealed that this method of juice addition after churning curd is appropriate and gave desirable flavour, body and texture (consistency) and appearance to the product.

4. CONCLUSION

Ginger juice could be successfully utilized for preparation of lassi. Addition of ginger juice in lassi improved the sensory quality and acceptability of the product. Besides typical flavor, it also adds medicinal properties to the product. Such flavoring did not appreciably affect the composition of *lassi*. The most acceptable quality lassi can be prepared by using 3.0% ginger juice.

5. ACKNOWLEDGEMENT

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