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Studies on Organoleptic, Physicochemical and Microbiological Quality of Lassi Sold in and around Hyderabad

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Abstract:

The present study was carried out to evaluate organoleptic, physiochemical and microbiological quality of Lassi sold in and around Hyderabad city, India. The overall acceptability score of the Lassi samples collected from organized sector was high (8.45), slightly less in semi organized sector (8.23) and least (7.65) in the hawkers samples. The pH, acidity and free fatty acids values were 0.81,4.05 and 0.150(µeq/g)for organized, 0.79, 3.99 and 0.180(µeq/g) for semi organized, 0.83, 4.10 and 0.210(µeq/g) for hawkers sector samples respectively. The total viable counts were $7.01x10^7$CFU/ml, $9.00x10^7$CFU/ml and $9.71x10^7$CFU/ml, LAB counts were $5.68x10^5$CFU/ml, $6.12x10^5$CFU/ml and $7.28x10^5$CFU/ml, Coliform counts $8.1x10^1$CFU/ml, $9.5x10^1$CFU/ml and $2.58x10^2$CFU/ml and Yeast and Mould counts $4.5x10^2$CFU/ml, $6.8x10^2$CFU/ml and $2.81x10^3$CFU/ml in organized, semi organized and hawkers samples respectively. The incidence was nil, 16% and 36% for *Salmonella*, 28%, 36% and 56% for *Staphylococcus*, 36%, 44% and 72% for *E.coli*, 8%, 16% and 32% for *Listeria* and 20%, 28% and 40% for *Shigella* and the counts were nil, $0.25x10^1$and $3.5x10^1$CFU/ml for *Salmonella*, $1.21x10^2$, $3.2x10^2$and $9.6x10^2$CFU/ml for *Staphylococcus*, $1.5x10^1$, $3.5x10^1$ and $8.51x10^2$CFU/ml for *E.coli*, $0.5x10^1$, $0.7x10^1$ and $1.5x10^1$CFU/ml for *Listeria* and $1.38x10^1$, $1.52x10^1$ and $2.58x10^2$CFU/ml for *Shigella* in organized, semi organized and hawkers samples respectively. The microbiological incidence and counts were high in hawkers samples, least in organized sector samples and in between in semi organized sectors.

Keywords **—Lassi, Sensory quality, Microbiological quality, Organized sector, Semiorganized sector, Hawkers.**

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I. INTRODUCTION

Fermented milk products constitute a vital component of human diet in many regions of the world. Fermentation of milk by suitable starter culture has several benefits especially, therapeutic purpose and increased palatability. The nutritive value of fermented milks will be elevated during fermentation and assimilation will be improved. Indigenous fermented milks like Dahi (curd), Lassi, Buttermilk, Srikhand, etc, are the prominent products in Indians' diet. At industrial level, lassi is prepared from Dahi breaking and mixing sugar syrup/ salt flavoured followed by packing and stored under refrigerated conditions. It is estimated that 9.1% of total milk produced in India is converted into various fermented milk products [6]. The variants of lassi include Buttermilk, Chhas, Mattha are consumed in some regions. Lassi is a white, creamy white, viscous liquid with a sweet rich aroma and mild high acidic taste. It is either favoured with salt or sugar, together with condiments, depending on regional preferences. Due to creamy consistency sweet rich aroma and mild acidic flavour, lassi becomes refreshing, palatable product [11]. Salted lassi is more popular in Southern India whereas sweetened lassi is popular in Northern parts. It can be flavoured with

mint, cumin, fruit, or fruit juices and any spices like chilli, ginger, garlic.

Even though general methods of preparation of lassi is known, no serious attempts to standardize it's composition and method of manufacture for production in large quantities [27]. Unless some quality standards are fixed, consumer will not be assured of getting good quality lassi. Hyderabad is a metropolitan city, where in different categories of people live, taking various types of fermented milks as per their preferences. Number of brands of lassi is marketed in Hyderabad apart from semi organized sector and street vendors (hawkers). Much research work was not published on the quality of lassi, the present work was undertaken to evaluate the sensory, physicochemical and microbiological quality of lassi sold by different sources.

II. MATERIALS AND METHODS

A preliminary study was conducted about the sources and types of lassi marketed in and around Hyderabad city. On the basis of survey, it was decided to collect the lassi samples from organized sector, semi organized sector and street vendors(hawkers). Twentyfive samples each from organized, semi organized and street vendors are collected from markets, packed in poly-ethene bags and kept in ice boxes. Then they were transported to the laboratory of Veterinary Public Health and Epidemiology, College of Veterinary Science, Rajendra Nagar and stored in refrigerator till the lab work was undertaken.

The fresh lassi samples were evaluated for sensory quality by a panel of five experienced judges following nine-point hedonic scale [17]. The acidity was estimated by titration method and pH was measured using electronic pH meter following the procedures listed [18].The free fatty acids was estimated by the method recommended [9]. SPC, LAB count, coliform count and yeast and mould was estimated by using nutrient agar, Lactobacillus selective agar, Mac Conkey agar and Potato Dextrose Agar were used for enumeration of standard plate count, lactobacillus count, coliform count and yeast and mould counts respectively following the procedures given in IS:5403 [20]and IS:5401 [19]. Various media like Bismuth SulfiteAgar(*Salmonella*), Eosin Methylene Blue Agar (*Escherichiacoli*), Tryptic Soy Agar (*Staphylococcus*), Brain Heart Infusion Agar (*Listeria*) and Deoxy Chocolate Agar (*Shigella*) were used for detection of pathogens.

All medias were obtained in dehydrated forms and prepared according to manufacturer's instructions. Glassware such as petri dishes, test tubes, pipettes, conical flasks and bottles were sterilized in a hot air oven at 160^{o} C for 2 hours. Distilled water and liquid media were sterilized by autoclaving at 121^{0}C for 15 minutes at 15 lbs pressure. One ml of Lassi sample was dissolved in 9ml of sterilized distilled water to make 1:10 dilution, one ml of this dilution added to 9ml distilled water and so on to get $1:10^{10}$ dilution. One ml of selected dilution is transferred into a petri dish and sufficient amount [10-15 ml] of respective liquid media was poured into plates. After proper solidification of the culture media, the plates were inverted and were incubated at 37^{o}C for 24 to 48 hours, except for Yeast and Mould plates which were incubated at 25^{o}C for 3-5 days. After the incubation period, the plates were observed for typical colonies of each microorganism and colonies were counted with the help of colony counter. The results were recorded as CFU/ml. The specific biochemical tests were conducted like gram staining, catalase test, urease test, sugar fermentation test, oxidase test etc. for confirming specific microorganism.

III. RESULTS AND DISCUSSION

A. Organoleptic Evaluation

The sensory score of Lassi samples from different sources were presented in Table I.

The flavour score of the Lassi samples was high (8.71) for the samples from organized, least (7.36) with hawkers and in between for semi organized samples. The flavour score of 8.5 reported [45] was almost similar to flavour score observed in the present study for organized sector samples, whereas slightly less score was repoted[29], [13], [40]. Very low score of 7.6 for organized samples wasalso reported [36]. The flavour score of 8.38 reported [21], was slightly higher than the score reported in

the present study for semi organized samples, slightly less of 8.05 [40], whereas low score of 7.27 was also reported [10]. A flavour score of 7.5 [5] and 7.5 [28] reported was almost similar to the flavour of observed in the present study for Hawkers whereas slightly less scores of 7.25 [30] and 7.2 [12] was also reported.

TABLE I
SENSORY SCORES OF LASSI SAMPLES FROM DIFFERENT SOURCES

Characteristics	Organised sector	Semi organised sector	Hawkers
Flavour	8.71	8.24	7.36
Body and Texture	8.49	8.38	7.53
Acidity	8.19	8.09	7.60
Colour and Appearance	8.41	8.29	8.11
Overall Acceptability	8.45	8.23	7.65

The body and texture score of lassi samples was 8.49, 8.38, and 7.53 for organised, semi organised, and hawkers respectively in the present study. Body and texture score of lassi samples of 8.25 [45] was slightly less than the score in the present study for organised sector, where as low scores of 8.03, 8.19 and 8.2 for organised sector samples was reported [36], [29], [21] from different places. The body and texture score of 8.3 in the present study for semi organised sector samples was almost similar to the score of 8.22 [12], whereas low scores of 8.1 and 7.99 were reported [13], [28]. A score of 7.5 observed in the present study for hawkers samples was less than score of 7.73 [35] and more than the scores of 7.38 [12] and 7.14 [10]. The body and texture of lassi varies from demand, as some consumer prefer viscous body while others like thin body, majority prefer medium bodies lassi [29].

The acidity score of lassi samples from organised, semi organised and hawkers in this study were 8.19, 8.09 and 7.60 respectively. The highest acidity score was observed in the samples from organised sector, which was almost similar to the acidity score reported [35]. The least acidity score was observed in the samples from hawkers (7.60), which was in close agreement with other findings of 7.2 [10], [12].

The colour and appearance scores of lassi samples in the present study from organised, semi organised and hawkers sources were 8.41, 8.29 and 8.11 respectively. The colour and appearance score was highest in the samples from organised sector (8.41), which was almost similar to the score of 8.44 [13], but more than the scores of 8.00 [45] and 8. 3 [40] reported. The colour and appearance score for the samples of semi organised sector in the present study was 8.29, which was in agreement with the score of 8.25 [21], but higher than the scores of 8.02 [29], 7.2 [41] and 7.3 [2] reported. The scores of 7.46 [28], 7.53 [19] and 7.56 [12] reported were lower than the score obtained in the present study (8.11) for samples collected from hawkers, whereas the score of 8.00 reported [35] was in close agreement with the present study.

The overall acceptability scores of Lassi samples are highest for the organised sector samples (8.45), least for the hawkers samples (7.65), and in between for the semi organised samples (8.23). The score of 8.45 observed in the present study from organised sector was almost similar to the score of 8.5 [45] whereas it is more than the scores of 8.29 [29] and 8.30 [13] reported. The scores of 7.39 [34] reported was almost similar to the score of hawker sample in the present study. The scores of 7.1 [46], 7.33 [21], 7.29 [10] and 7.10 [3] reported were lower than the overall acceptability score of Hawker samples in the present study. A score of 8.25 [5],[36] was almost similar to the score of semi organised sector lassi samples observed in the present study, whereas lower score of 8.01 [35] was also reported.

B. Physicochemical Quality

Thephysicochemical properties scores for various lassi samples were presented in Table II.

All the acidity values of Lassi samples from organised, semi organised and hawkers samples in the present study were 0.81, 0.79 and 0.83 (% LA) respectively. The acidity values of the lassi samples in the present study were differing slightly. The acidity values of Lassi samples from organised sector was similar to the values reported earlier [29], [15], [40] whereas slightly higher values were reported [46]. The acidity value of 0.84% LA reported [21] was higher than the acidity value observed in Hawkers samples in the present study.

Very less acidity values of 0.70% [26], [4], 0.73% [8], 0.74% [4], 0.75% [23] and 0.65% [14] were reported. Very high acidity value of 0.95% [13], 0.98% [39] and 1.02% [12] were also reported.

TABLE III
PHYSICOCHEMICAL PROPERTIES SCORESOF LASSI SAMPLES FROM DIFFERENT SOURCES

Source	Acidity	pH	Free Fatty Acids (µeq/g)
Organised	0.81	4.05	0.150
Semi organised	0.79	3.99	0.180
Hawkers	0.83	4.10	0.210

The pH value of lassi sample was 4.05 for organised sector, semi organised sector, 3.99 for semi organised sector and 4.10 for hawkers samples in the present study. The pH value of 3.99 observed for semi organised sector samples in the present study was similar to the pH value observed [29]. A pH value of 4.01 [13] and 4.1 [12] reported were almost similar to the pH value observed for the organised sector samples in the present study. Higher pH values of 4.18 [5], 4.2 [1], 4.21 [10], 4.24 [24], 4.3 [4], 4.31 [12] and 4.36 [40] were observed for market samples from different places.

The free fatty acid values of organised, semi organised and hawker samples in the present study were 0.150, 0.180 and 0.210 respectively. The free fatty acid contents observed in the samples from three sources were higher than the values reported from different places [43].

C. Microbiological Quality Evaluation

The SPC, LAB, Coliform and yeast and mould counts of Lassi samples from different sources were presented in table III.

The Standard plate count was less ($7.01x10^7$CFU/ml) in lassi samples collected from organised sector, higher ($9.00x10^7$CFU/ml) from semi organised sector and highest ($9.71x10^7$CFU/ml) from Hawkers in the present study. The counts in the present study from organised sectors was almost similar to the counts of $7.92x10^7$[41] reported, whereas lower counts of $6.35x10^7$CFU/ml reported [46]. The standard plate counts of $8.50x10^7$ [29] was reported from Kolhapur, which was less than the counts from semi organised sector in the present study. A range of $14.95x10^7$ to $16.32x10^7$ CFU/ml[35] reported in the samples from road side sellers was very high than the counts observed in the present study from hawkers. Very low counts of $13.2x10^2$ CFU/ml reported from organised sector samples collected from Rahuri[34].

TABLE III
MICROBIOLOGICAL QUALITY EVALUATION (CFU/ML) OF LASSI SAMPLES FROM DIFFERENT SOURCES

Sector	SPC	LAB count	Coliform	Yeast and mould
Organized	$7.01x10^7$	$5.68x10^5$	$8.10x10^1$	$4.50x10^2$
Semi organized	$9.00x10^7$	$6.12x10^5$	$9.50x10^1$	$6.80x10^2$
Hawkers	$9.71x10^7$	$7.28x10^5$	$2.58x10^2$	$2.81x10^3$

The LAB counts were $5.68x10^5$, $6.12x10^5$ and $7.28x10^5$CFU/ml from organized, semi organized and hawkers samples respectively in the present study. The counts of $5.68x10^5$CFU/ml observed in the samples from organised sector in the present study was almost similar to the counts of $5.21x10^5$CFU/ml reported from Kolhapur city [29]. A count of $4.33x10^7$CFU/ml reported [12] was higher than the counts ($6.12x10^5$CFU/ml) observed for semi organised sector samples in the present study. Very low counts of $1.2x10^4$CFU/ml was reported [8] in the market samples.

The Coliform counts were less ($8.1x10^1$CFU/ml) in Lassi samples collected from organized sector, higher ($2.58x10^2$CFU/ml) in sample from hawkers and in moderate ($9.5x10^1$CFU/ml) in the samples from semi organized sector. The coliform count of $2x10^1$CFU/ml[25] reported from organised sector was less than the counts ($8.1x10^1$CFU/ml) observed in the samples from organised sector in the present study. The coliform count in the samples from semi organised sector in the present study was less than the counts of $14.67x10^1$CFU/ml[29] reported in lassi samples from Kolhapur city. Very low count of 4.00 CFU/ml[34] was reported in the market samples. Very high counts of $6.00x10^7$CFU/ml[35] and $6.20x10^7$CFU/ml[7] were reported in the lassi samples from street vendors compared to counts of $2.58x10^2$CFU/ml observed in hawkers samples in the present study.

The Yeast and Mould count was low ($4.5x10^2$ CFU/ml) in Lassi samples collected from organised sector, moderate ($6.8x10^2$CFU/ml) in the samples

from semi organised sector and high ($2.81x10^3$ CFU/ml) in the samples from Hawkers. A count of $2.15x10^2$ CFU/ml reported in samples from Kolhapur city [29] was less than the count observed in the samples from organised sector in the present study. Very low count of 10 CFU/ml [42] in the samples from organised sector was also reported. The yeast and mould count of $1.156x10^3$ CFU/ml reported [2] was higher than the counts observed in semi organised sector samples in the present study. The yeast and mould counts of $9.20x10^6$ CFU/ml [31], [36] and [41], $9.00x10^7$ CFU/ml [35], $8.92x10^7$ CFU/ml [7] and $9.27x10^7$ CFU/ml [28] reported from hawkers samples were higher than the counts from hawkers samples in the present study.

The incidence of pathogens in Lassi samples from different sources was presented in the table IV.

TABLE IIIV
INCIDENCE OF PATHOGENS OF LASSI SAMPLES FROM DIFFERENT SOURCES

Pathogens	Organised	Semi organised	Hawkers
Salmonella	nil	4(16)	9(36)
Staphylococcus	7(28)	9(36)	14(56)
E.coli	9(36)	11(44)	18(72)
Listeria	2(8)	4(16)	8(32)
Shigella	5(20)	7(28)	10(40)

An incidence of nil, 16% and 36% for *Salmonella*, 28%, 36% and 56% for *Staphylococcus*, 36%, 44% and 72% for *E.coli*, 8%, 16% and 32% for *Listeria* and 20%, 28% and 40% for *Shigella* in the lassi samples from organized, semi organized and hawkers lassi samples respectively was observed in the present study. All Lassi samples tested were *Salmonella* free [29],[26]. Low incidence of *Salmonella* was reported [32] in Nigeria. E.coli was not detected in Lassi samples [21].

High incidence of *E.coli* was reported [43] in the samples from Hyderabad. *Staphylococcus* incidence was 100% [43] in hawker samples which was very high than the present study (56%). The incidence (20%) of *Listeria* observed in unbranded samples [37] was less than the incidence (32%) in the present study from hawker samples.

The counts of pathogens in the lassi samples from different sources were presented in table V.

A count of nil, $0.25x10^1$ and $3.5x10^1$ for *Salmonella*, $1.21x10^2$, $3.2x10^2$ and $9.6x10^2$ for *Staphylococcus*, $1.5x10^1$, $3.5x10^1$ and $8.5x10^2$ for *E.coli*, $0.5x10^1$, $0.7x10^1$ and $1.5x10^1$ for *Listeria* and $1.38x10^1$, $1.52x10^1$ and $2.58x10^2$ for *Shigella* was observed in 25 samples each from organised, semi organised and hawkers samples respectively in the present study.

TABLE V
THE COUNTS OF PATHOGENS (CFU/ML) OF LASSI SAMPLES FROM DIFFERENT SOURCES

Pathogens	Organised	Semi organised	Hawkers
Salmonella	nil	$0.25x10^1$	$3.5x10^1$
Staphylococcus	$1.21x10^2$	$3.2x10^2$	$9.6x10^2$
E.coli	$1.5x10^1$	$3.5x10^1$	$8.51x10^2$
Listeria	$0.5x10^1$	$0.7x10^1$	$1.50x10^1$
Shigella	$1.38x10^1$	$1.52x10^1$	$2.58x10^2$

The counts of *Salmonella* (4.2 – 8.8) reported [43] were almost similar to the counts observed in the present study from semi organised and hawker samples. Higher counts of log10 3.9 CFU/ml [16] were observed in Egypt in the organised sector samples, whereas no *Salmonella* was detected in the present study. Higher counts of *Staphylococcus*of $8.58x10^2$ to $3.52x10^4$CFU/ml were reported [43] compared to similar samples in the present study.

IV. CONCLUSIONS

The Organoleptic quality was high in organised sector, less in hawkers and moderate in semi organised sector and the microbiological incidence and counts were high in Hawkers, least in organised sector and in between in semi organised sector in the present study.

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