Total phenolic content (TPC) and quality of herbal lassi fortified with Turmeric (Curcuma longa) extract

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Received: 17-07-2018 Accepted: 24-11-2018
DO: 10.18805/ajdfr.DR-1391

ABSTRACT

Lassi, a popular curd based traditional fermented milk beverage of India. Lassi was prepared from standardized cow milk curd using 1% commercial yoghurt culture containing Streptococcus thermophilus and Lactobacillus bulgaricus. Maximum concentration of herbal extract added during processing of herbal lassi was optimized with Turmeric (Curcuma longa) @ 1% (v/v) in lassi on the basis of sensory evaluation. Total phenolic content (TPC) of turmeric extract based herbal lassi was also evaluated. TPC of the turmeric based herbal lassi was measured as Gallic Acid Equivalent (GAE) using a double beam UV-visible spectrophotometer at 765 nm. The TPC of the turmeric extract fortified lassi was found to be 0.226±0.001mg of GAE/g and differed significantly (P<0.05) with the control lassi (without any herbal extract) which showed a TPC of 0.124±0.01 mg of GAE/g. Turmeric lassi was found having high phenolic content with good sensory property and found acceptable up to 9 days when stored at 7±2 °C in a glass bottle.

Key words: Fermented milk, Gallic acid, Herbal, Lassi, Spectrophotometer, Turmeric, TPC.

INTRODUCTION

The health benefits of different types of foods have been investigated for many years. The market for fermented milk products is growing at a faster rate throughout the world. In India around 9 % of the total milk produced is converted into fermented milk products with an annual growth rate of more than 20% (Singh et al., 2006). Milk based soft drinks would find its place as a refreshing and nourishment drink. Lassi is one of the most popular fermented dairy beverage in India prepared by churning of curd. Lassi is known to be an extraordinary nutritional material with all essential and non-essential amino acids. Moreover, these drinks are light, refreshing, healthful and nutritious but less acidic than fruit juices and offer good profit margin. The functionality of lassi increases with the addition of probiotic microorganisms and incorporation of antioxidant rich herbal extracts that provides strong antioxidant power endow with value addition to the finished product. Consumption of herbs has significant health promoting effect and reduces the incidence of cardiovascular disease, cancer and various degenerative diseases (Singh et al., 2006; Craig, 1999; Shishodia et al., 2005). Antioxidants are the chemical substances that reduce or prevent oxidation and have the ability to counteract the damaging effects of free radicals in tissues and thus are believed to protect against cancer, arteriosclerosis, heart disease and several other diseases. Since pre-historical times, herbs and spices have been used not just as food flavorings, but also for its medicinal and antisepticuse as well as for their preservative action that is derived from their antimicrobial and antioxidant constituents (Almeida-Doria and Regitano-Darce, 2000). Among the several fruits, vegetables, herbs and spices, turmeric (Curcuma longa) is a well-known item in our daily diet. Turmeric is the root of the perennial herb Curcuma longa, belonging to the ginger family is cultivated in tropical regions of south and south-east Asia. The most active component of turmeric is curcumin, which makes upto 2-5% of the spice. Several studies have shown curcumin to be a potent antioxidant with its activity 10 times more than that of the well-known antioxidant vitamin E (Khopde et al., 1999). The antioxidant property of curcumin can prevent rancidity of foods and provide foodstuffs containing less oxidized fat or free radicals. Curcumin is listed for use in dairy products, fats, oils and emulsions, edible ices, fruit and vegetable products, confectionery, cereal products, bakery wares, meat and meat products, fish and fish products, egg and egg products, spices, soups, sauces and protein products. Therefore, it is evident that turmeric possesses good anti-oxidative properties. However, no study has been done that assessed the antioxidant level of these sources after fortification in lassi. The objective of this investigation was determination of the total phenolic content (TPC) of the herbal lassi fortified with turmeric extract and evaluation of its chemical, microbiological and sensory quality.

MATERIALS AND METHODS

Collection of milk and herbs: Raw cow milk was collected from the cattle farm of West Bengal University of Animal and Fishery Sciences, Mohanpur, Nadia, WB.

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and Fishery Sciences, Mohanpur during summer season from the herd of Sahiwal breed mainly fed on paddy straw, hybrid napier and nutritfeed seeds. It was subsequently standardized to 3.0% fat and 8.5% SNF and further used for the preparation of Yoghurt. Turmeric was procured from local market at Mohanpur, Nadia.

**Bacterial culture:** Freeze dried yoghurt culture (YC-470) containing *Streptococcus thermophiles* and *Lactobacillus bulgaricus* was purchased from the market.

**Preparation of curd, herbal extract and herbal lassi:** Curd was prepared following the method described by Ashwani et al. (2003). Fresh turmeric was peeled off and then cut into small pieces. After that each herb pieces were boiled in water for 1 min. Then it is grinded in mixer and the juice was extracted by filtering with muslin cloth. Lassi was prepared following the method described by Ashwani et al. (2003) with slight modification (Fig 1).

**Chemical and microbiological analysis:** Lassi was analysed for fat, protein, lactose, sugar following the methods described in AOAC (1990). The standard plate count (SPC), coliform count and yeast & mould count in lassi samples were determined following the methods a described by APHA (1995).

**Phenolic analysis**

**Extraction of sample:** Total phenolic and antioxidant activity measured in methanol extract (AOAM) analysis were prepared using the method of Swain and Hills (1959), with some modifications. Three gm of sample were mixed with 25ml methanol and homogenized using the Ultra-Turrax homogenizer. The homogenates were kept at 4°C for 12 hrs. and then centrifuged at 15000 rpm for 20 min using vacuum micro centrifuge. The supernatants were recovered and stored at 20°C until analysis. The pellet was re-dissolved with 20 ml dichloromethane and homogenized for antioxidant activity measured in dichloromethane extract (AOAD) analysis. The homogenates were centrifuged at 15000 rpm for 20min. The supernatants were recovered and stored at -20°C until analysis. In general, methanol extraction and dichloromethane extraction were used for determining hydrophilic and lipophilic antioxidant activity.

**Total phenolic estimation:** The total phenols of all extract were measured at 765 nm by Folin-Ciocalteu reagent (McDonald et al., 2001). The dilute methanolic extract (0.5ml of 1:10 g/ml) or Gallic acid (standard phenolic compound) was mixed with Folin-Ciocalteu reagent (5ml, 1:10, diluted with distilled water) and aqueous sodium carbonate (4ml, 1M). The mixture was allowed to stand for 15min and the total phenols were determined by spectrophotometer at 765 nm. The standard curve was prepared using 1, 50, 100, 150, 200 and 250 mg/l solutions of Gallic acid in methanol: water (50:50, v/v). Total phenol values are expressed in terms of Gallic acid equivalent (mg/g of dry mass), which is a common reference compound.

**Sensory evaluation:** Sensory evaluation of lassi was done by using 9 point Hedonic Scale as describe in Amerine e al., (1965). Sensory evaluation was done by a panel of five trained judges of the institution.

**Statistical analysis:** Observed data were analyzed for one-way ANOVA using General Linear Model (GLM) method of IBM SPSS Statistics, version 21, 2012 software.

### Table 1: Sensory properties of lassi prepared by using different levels of turmeric extract.

| Parameter                  | Control   | Levels of turmeric extract in Lassi | 1%   | 2%   | 3%   | 4%   |
|----------------------------|-----------|-------------------------------------|------|------|------|------|
| Colour and Appearance      | 7.66±0.11a | 7.50±0.13a                          | 7.45±0.13a | 7.33±0.12b | 6.66±0.12c |
| Flavour                    | 8.33±0.10a | 8.2±0.11b                           | 7.33±0.13b | 6.0±0.11d | 4.33±0.11d |
| Body and texture           | 8.33±0.11a | 8.25±0.13b                          | 7.7±0.11c | 7.0±0.12d | 7.0±0.12d |
| Overall acceptability      | 8.30±0.11a | 8.23±0.12                            | 7.33±0.10b | 6.66±0.11c | 5.66±0.11d |

Mean±S.E with different superscripts within a row differ significantly (P<0.05), (n=5).
RESULTS AND DISCUSSION

Chemical composition of lassi: Cow milk standardize to 3% fat and 8.5% SNF was used for preparing curd by using Yoghurt culture (Streptococcus thermophilus and Lactobacillus bulgaricus). This prepared curd was used for the preparation of lassi with the addition of sugar syrup @ 12% and stabilizer @ 0.5% (v/v). The final product contained average 18, 1.3, 3.5, 1.2 and 0.4% total solid, fat, protein, lactose and ash respectively with final acidity of 0.432% of Lactic Acid (LA).

Standardisation of the level of herbal extract: Level of herbal extracts for the preparation of herbal lassi was fixed on the basis of sensory evaluation. Herbal lassi prepared by using different combination of turmeric extracts individually was evaluated by sensory evaluation with the control sample where no herbal extract was added.

Effect of different level of turmeric extract on the sensory quality of lassi: The comparative score of sensory characteristics of the control lassi and different level of turmeric extract containing lassi sample stored at 30±2°C are shown in Table 1. The result obtained revealed that the lassi containing 1% turmeric extract scored significantly (P<0.05) better than other treated sample. The overall acceptability score of control lassi was 8.30±0.11 whereas the turmeric extract containing lassi scored 8.23±0.12, 7.33±0.10, 6.66±0.10 and 5.66±0.11 for 1%, 2%, 3% and 4% turmeric lassi (v/v) respectively. The difference between the values is statistically significant. 1% turmeric extract (v/v) lassi showed significantly highest overall sensory score as compared to other treated lassi samples. No significant difference was observed between control lassi and herbal lassi treated with 1% turmeric extract. Therefore further study was done using herbal lassi containing 1% turmeric extract (v/v). These results were in agreement with those obtained by Foda et al. (2008) who reported that turmeric in different concentration had significant effect on the sensory quality and acceptability of fresh and stored yoghurt.

Total phenolic content of herbal lassi: On the basis of sensory evaluation addition of 1% (v/v) turmeric extract was selected for preparation of herbal lassi. Total phenolic content (TPC) of herbal lassi along with control lassi (without any herbal extract) were determined. The TPC of turmeric lassi is given Table 2 and is measured in terms of mg GAE/gm. The TPC of turmeric lassi was found to be 0.226±0.001 mg GAE/gm whereas the control lassi showed TPC of 0.124±0.001 mg GAE/gm. From the result it was revealed that 1% v/v turmeric lassi showed significantly higher TPC than plain lassi. The difference in TPC among the lassi samples was found to be statistically significant (P<0.05).

Turmeric is widely used as a spice, preservative, colouring matter and has wide range of medicinal and pharmacological applications. It exhibits anti-inflammatory, anti-HIV, anti-bacterial, antioxidant, nematocidal, antiparasitic, antispasmodic and anti-carcinogenic activities. Niranjan and Prakash (2008) reported that it is a potent scavenger of a variety of Reactive Oxygen Species (ROS) including superoxide anion, hydroxyl radical, peroxynitrite, etc. The present results could not be adequately compared due to lack of published literature on the Total Phenolic Content (TPC) of turmeric extract added herbal lassi though in a similar kind of study Ganguly et al. (2017) found higher TPC in betalain powder fortified lassi as in which they reported polyphenol content of 862.1 g /100g which was higher than the polyphenol content of 755.32g /100g in control lassi where no betalain powder was added. Ankitha et al. (2018) reported higher DPPH antioxidant activity in salubrious curcumin fortified whey beverage which supported the higher antioxidant activity of the turmeric extract where curcumin is the active functional constituent.

Changes in chemical, microbiological and sensory properties of turmeric lassi during storage at 7±2°C: Storage stability of turmeric lassi was studied at 7±2°C. The product was analysed for change in acidity, colour and appearance, flavour, body and texture, overall acceptability and viable counts at 2 days interval. The changes in different parameters of turmeric lassi are shown in Fig 2 and Table 3 and 4. The result revealed that the acidity increases with the increase in storage period. The turmeric lassi was accepted upto 9 days of storage at 7±2 °C.

| Parameters | Types of Lassi | TPC (mg GAE/gm) |
|------------|---------------|-----------------|
| Control    | 0.124±0.001   |
| Turmeric Lassi (1% v/v) | 0.226±0.001 |

Mean±S.E with different superscripts within a row differ significantly (P<0.05), highly significantly (P<0.01); (n=5).

| Parameters | No of storage days |
|------------|--------------------|
|            | 3                  | 5                  | 7                  | 9                  |
| Colour     | 7.66±0.12a         | 7.66±0.10a         | 7.66±0.10a         | 7.33±0.11a         | 7.0±0.13a          |
| Flavour    | 8.66±0.10a         | 8.56±0.10a         | 8.33±0.11a         | 7.66±0.11a         | 7.33±0.13b        |
| Body and texture | 8.66±0.12a   | 8.66±0.12a         | 8.54±0.11a         | 8.33±0.13a         | 7.66±0.12b        |
| Overall acceptability | 9.0±0.12a     | 8.83±0.12a        | 8.83±0.13a         | 8.66±0.12a         | 7.33±0.02b       |

Mean±S.E with different superscripts within a row differ significantly (P<0.05), highly significantly (P<0.01); (n=5).
The sensory evaluation of turmeric lassi was done during storage at 7±2 °C. The overall acceptability showed that the turmeric lassi was acceptable up to 9 days when kept in glass bottle at 7±2 °C. The details of the sensory evaluation were shown in the Table 3. The result is in agreement with those obtained by Mourya (2012), where he found that the curcumin fortified lassi had a shelf life of 20 days at 4 ±1°C and 90-95% RH when packed in low density polyethylene (LDPE) pouches or in poly ethylene terephthalate (PET) bottles.

**Microbiological count of turmeric lassi during storage at 7±2°C.**

| Microbiological count (log10cfu/ml) | No of storage days |
|--------------------------------------|--------------------|
|                                      | 1                  | 3                 | 5                 | 7                 | 9                 |
| SPC                                  | 4.78±0.02<sup>a</sup> | 5.90±0.02<sup>b</sup> | 6.50±0.04<sup>c</sup> | 7.66±0.04<sup>d</sup> | 8.60±0.05<sup>e</sup> |
| Coliform                             | Nil                | Nil               | Nil               | Nil               | Nil               |
| Y and M                              | Nil                | Nil               | Nil               | Nil               | Nil               |

Means±S.E with different superscripts within a row differ significantly (P<0.05) (n=3).

**Microbiological quality of turmeric lassi during storage at refrigeration temperature (7±2 °C):** Microbiological analysis of turmeric lassi was done to assess the shelf life at 7±2 °C during storage. Standard plate count (SPC), Coliform count and yeast and mould count of turmeric lassi was given in the Table 4. The SPC count of turmeric lassi in storage showed an increased from the initial day to the 9th day of storage whereas coliform and yeast and mould count remained nil during storage. The coliform count of the present study was supported by Mourya (2012) where he reported the absence of coliform in the curcumin fortified lassi sample during storage period.

**CONCLUSION**

Lassi is a fermented milk product having good nutritional and therapeutic value. It can be made more nutritious by the addition of different types of herbs. Extract of turmeric was added to lassi for the preparation of antioxidant rich herbal lassi. One percent (v/v) turmeric extract was finalised for addition to the lassi on the basis of sensory evaluation. On the basis of total phenolic content, chemical, microbiological and sensory evaluation lassi prepared by addition of turmeric juice @ 1% (v/v) was adjudged best. The final products showed a shelf life of 9 days on the basis of chemical, microbiological and sensory tests when kept in a glass bottle and stored at 7±2°C.

**REFERENCES**

Almeida-Doria, R.F. and Regitano-Darce, A.B. (2000). Antioxidant activity of rosemary and oregano ethanol extracts in soyabean oil under thermal oxidation. *Ciencia e Tecnologia de Alimentos*, 20, May/August http://www.scielo.br

APHA, (1995). American water works association and water Pollution Control Federation, 1995. 19th edition. American Public Health Association. 1015 fifteen street, NW, Washington, DC.

Ankitha, R., Laxmana Naik and Sharma, A. (2018). Salubrious curcumin fortified whey beverage formulation and study its antioxidant property. *Int. J. Sci. Enng. Mgmt.*, 3(5): 74-80.

AOAC, (1990). Official Method of Analysis of AOAC Intl. 15th ed. Method 947.05.Association of Official Analytical Chemists, Arlington, Virginia, USA.

Amerine, M.A., Pangborn R.M., Roessler E.B. (1965). Principles of sensory evaluation of food. In: Food Science and Technology Monographs. Academic Press, New York. Pp.338-339.

Ashwani Kumar, Solankey, M.J., Suneeta, P., Chauhan, A.K. (2003). Storage related proteolysis in lassi. *Indian. J. Dairy Sci.*, 56(6):394-396.

Craig, W.J. (1999). Health promoting properties of common herbs. *Am. J. Cli. Nutr.*, 70:491s-499s.

Foda, M.I., El Aziz M.A. and Awad, A.A. (2008). Chemical, rheological and sensory evaluation of yoghurt supplemented with turmeric. *Int. j. Dairy Sci.*, 2(3): 252-259.

Ganguly, S., Chakrabarty, C. and Bandypadhyay, K. (2017). Development and characterization of biocolour (Beta vulgaris) enriched low calorie Lassi (Yoghurt based beverage). *Int. J. Curr. Microbiol. App. Sci.*, 6(4): 2265-2270.

Khopde S.M., Priyadarsini K.L., Venkatesan P., Rao M.N.A. (1999). Free radical scavenging ability and antioxidant efficiency of curcumin and its substituted analogue. *Biophys. Chem.*, 80:85-91.

McDonald S., Prenzler P. D., Autolovich M. and Robards K. (2001). Phenolic content and antioxidant activity of olive extracts. *Food Chem.*, 73: 73-84.
Mourya, N.K. (2012). Development of technology of curcumin fortified lassi with enriched functional attributes. M. Tech Thesis. National Dairy Research Institute, Karnal, Haryana, India: 80-85.

Niranjan, A. and Prakash, D. (2008). Chemical constituents and biological activities of turmeric (Curcuma longa L) – a review. *J Food Sci. Technol.*, 45(2): 109-116.

Shishodia S., Sethi G., Aggarwal, B.B. (2005). Curcumin: Getting back to the roots. *Ann. N. Y Acad. Sci.*, 1056:206–217.

Singh, B.P., Panesar S., and Nanda V. (2006). Utilization of carrot pomace for the preparation of a value added product, *World J. Dairy Food Sci.*, 1(1): 22-27.

SPSS. (2012). Statistical package for Social Sciences. Version 21.0.1.SPSS Inc. Illinois, USA

Swain, T., Hillis, W.E. (1959). Phenolic constituents of Prunus domestica quantitative analysis of phenolic constituents. *J. sci. Food Agric.*, 10:63-68.