**Development of Nutrient Rich Lassi Using Different Fruit Pulp**

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**ABSTRACT:**

Present investigation,was aimed to enrich Lassiwith selected fruit pulps to increase the functional nutrients and evaluate its nutritional, functional and sensory properties. Fruit pulps were added at different concentrations and was standardised based on scores of sensory parameters. Both Standard lassi (Plain – Lassi developed at Nandini Milk Parlour, Mysore Milk Dairy, Mysore) and fruit blended lassis were analysed for proximate composition for moisture, carbohydrates, protein, fat, fibre and ash; Quality parameters viz., titrable acidity, pHand specific gravity;Functional parameters viz., Vitamin C and antioxidants;sensory analysis were carried out on a 9 point hedonic scaleand Microbiological evaluation for safety was carried out. Fruit blended lassis showed increased level of Vitamin C, fibre and antioxidants than standard lassi. The developed fruits lassi helped to retain vitamin C which are present in fruits, as lassi are slightly acidic in nature, and vitamin C is proved to be stable in acidic medium. Sensory scores of fruit blended lassis were seen to be higher than standard. Microbiological results revealed that, these developed lassis were microbially safe.

**Keywords:** Lassi; Fruit; Antioxidant, Enrichment, Vitamin C

**INTRODUCTION**

Fermented milk products play an important role in human nutrition as far as therapeutic value of fermented milk is concerned. Significance of fermented milk in human nutrition has been well documented. Lassi is one of the popular, ready to serve indigenous fermented milk beverages. Lassi is served on large scale in cold drink bars and restaurants during summer in almost every state. Many times “Chhash” is also referred to as, "lassi" by technocrats in literature[1].However, Lassi is a popular product close to sweet stirred yoghurt has been used as a refreshing beverage from time immemorial in India, extremely in western, northern and central regions. Lassi is also popular in some other parts of the world too, it is prepared by stirring whole curd into a delicious drink with addition of sugar or salt, a small amount of cold water or ice to make the product flowable. The popularity of this product is not only because of its refreshing and delectable taste, but also due to its nutritive and therapeutic benefits and thirst-quenching quality [2].

Lassi is considered as digestible, nutritious and useful in gastrointestinal ailments [3]. The health benefits of lassi are the result of biologically active components that are present in milk and also, due to their suitably modulated activities produced through the action of lactic acid bacteria, recognition of the enormous therapeutic and nutritional value and used for the treatment of diarrhea, dysentery, chronic specific and non specific colitis, piles and jaundice. This practice has the scientific basis as the lassi contains advantageous microorganisms which attach on the intestinal surface and further multiply there. Besides, checking or controlthe growth of harmful organism it has nutritive properties in the form of vitamins, minerals, amino acids etc. Lassi is very low in fat but it has large amount of advantageous bacteria or their breakup products in the form of amino acids, peptides, vitamins, minerals, etc., which are useful for human and animal health [4].

Fruit lassis is enjoyed more and has good retention of antioxidants and vitamins[5].In India for all the classes of people the fruits such as guava, jackfruit, apple, wood apple, sapotaetc, are well liked and regularly consumed fruits.Fruits form anprincipal part of the diet and are usually regarded as good foods.They are vital sources of vitamin C, folic acid and dietary fibre [6].More than 90% of the ascorbic acid in the human diet comes from fruits and vegetables [7]. Foods of plant origin are capable of contributing appreciable quantity of nutrients needed by both children and adults if properly processed and blended [8]. Fruits are identiﬁed as rich sources of antioxidants and amply used to overcome oxidative stress. Use of natural dietary antioxidant sources to supplement the defective endogenous antioxidant system is gaining priority. The fact behind the health-beneﬁcial property of fruits is the large number of nutraceutical phytochemicals that they contain, viz., polyphenolsand vitamins [9]. Continuously growing demand for promising dietary antioxidant sources because of public consciousness has triggered the search for newer, economical, nutritional and multifunctional sources possessing free radicalscavenging potential.

Guava (*Psidiumguajava* L.) belongs to family *Myrtaceae*[10]. It’s prime role in reducing nutritive disorders which are due to insufficiency of vitamin C in humans [11].Apple is a richsource of minerals and vitamins. It is also reported to have anti-bacterial, anti-tumorandanti-mutagenic properties [12,13,14,15]. Avocado pear (*Perseaamericana*) species belongs to the family *Lauraceae*. Avocado is a highly nutritional fruit, rich in proteins, antioxidants and fiber, fats and oils and low in sugar[16,17,18].High consumption of Avacado has been shown to have a beneficial result on blood serum cholesterol levels [19].Plum is a rich source of vitamins particularly vitamin C and other macro and micronutrients[20].The ripened jackfruit is aexcellent source of carbohydrates, proteins and fibre and B-complex vitamins. Being aexcellent source of vitamin A and vitamin C, it aids in alleviating pancreatic ailments and aids in blood purification [21].Kiwi fruit is a excellent source of ascorbic acid and polyphenols [22]Some studies have shown that the extracts of kiwi fruits hinder cancer cell growth [23] and exhibit cell protection against oxidative DNA damage in vitro [24].Pear fruits are good source of vitamin C[25].Sapota (*Achrassapota Linn*.) belongs to family *Sapotaceae*, and isreportedtocontainsugars [26],acids [27],protein [28], phenolics, viz., gallic acid, chlorogenic acid, leucocyanidin and leucopelargsonidin [29], carotenoids, vitamin C and minerals such as potassium, calcium and iron [28]. In the traditional system of Indian medicine, decoction of sapota fruits is taken to ceasediarrhea, torelievepulmonaryailments, have diuretic action and are claimed to expel bladderandkidneystone [30].Date is a delectable fruit with the major component of carbohydrates (mainly the sugars; sucrose, glucose, and fructose), which may constitute about 70%. Dates are also aexcellent source of fiber, and contain many important vitamins and minerals, including significant amounts of calcium, iron and selenium [31,32,33,34,35]. Few studies have shown that dates and their aqueous extracts have demonstrated the free radical scavenging activity, inhibition of free radical-mediated macromolecular damages, antimutagenic, and immunomodulatory activities [36,37,38,39].Wood apple is an underutilized inspite of its good nutritional and therapeutic properties along with its delicate flavour. Wood apple used as folk medicine in treating dysentery, different infections [40],fruit consist phytochemicals which possess anti-oxidative, antifungal, hypoglycemic, hypolipidaemic and hepatoprotective properties [41,42].

On the other hand, lassi is rich in protein and fat but is deficient in iron and vitamin C. Combining fruits with lassi can produce a nutritionally rich food. With all the positive benefits of fruits and lassi, in the present study an attempt was made to standardise and develop different fruit blended lassis and evaluate its physico-chemical parameters. Different fruits which were selected for the study were, apple, avocado, dates, guava, jackfruit, kiwifruit, pear, plum, sapota and wood apple. These combinations of fruit blended lassis will not only prove to increase the sensory characteristics, it also improves the health benefits such as increasing the nutritional profile and functional components. The developed fruits lassi will also help to retain vitamin C which are present in fruits, as lassi are slightly acidic in nature, and vitamin C is proved to be stable in acidic medium. By carrying out simple technique of blending the fruit at household level and mixing with lassi will help in increasing the nutritive profile and healthy microbiota.

**2. MATERIALS AND METHODS**

**2.1. Materials**

Sugar and fruit pulp at Predicated levels were incorporated in curd for the preparation of lassi. The levels of sugar were kept constant for each treatment. On the basis of different levels of fruit pulp, lassi were prepared and evaluated for sensory, chemical and microbial quality.

**2.1.1.Collection of curd and other ingredients**

Good quality curd was purchased from Nandini Milk Dairy, MYMUL, Mysuru. Good quality sugar was purchased from local market, Mysuru.Good quality, Properly ripened, without any physical damage and microbial infection free fruits were procured from Mysuru Local Market. Ready to use Lion Dates syrup was used for the Standardization of dates lassi and Procured from Loyal world, Mysuru.

**2.1.2.Chemicals**

All chemicals and media used in the study were of analytical grade and were purchased from S D fine chemicals limited, Mumbai, Nice chemicals (P) Ltd., Kerala, India.All microbial medias materials were procured from HiMedia Laboratories pvt. Ltd., Mumbai.

**2.1.3 Packaging materials:**

The packaging materials used for lassi storage stability studies consisted low density polyethylene pouches which procured fromNandini Milk Dairy, MYMUL, Siddharthanagar, Mysuru.

**2.2. Methods:**

**2.2.1. Preparation of Standard sweet Lassi**

Preparation of Standard (control) sweet lassi was prepared from curd, sugar andwater as per the method followed at Nandini Milk Dairy, MYMUL, Siddhartha nagar, Mysuru, Karnataka. Sweet lassi was standardized for 100ml with 44ml of curd,15g of sugar; 44ml of water. Curd was taken and was blended for few seconds in the mixer and kept aside. Then blended curd, water and sugar was added and mixed for some times, later packed in LDPE Pouches, stored till analysis in Refrigerated temperature at (0-4°C).

**2.2.2. Preparation of lassis blended with different concentration of fruit pulp**

Curd was taken

Curd was blended for few seconds in the mixer and kept aside

Edible part of fruits were taken and chopped

Chopped fruits were added into mixer and grinded

Blended curd, water, grinded fruit pulp and sugar were blended

Packed in LDPE Pouches

Stored at Refrigerated condition(0-4°C)

**Fig 1:Preparation of different lassis blended with different concentration of fruit pulp**

**Note:** For the preparation of dates lassi, lion dates syrup was used. For guava lassi edible part of guava fruits was taken, chopped, blanched in boiling water until guava fruits gets softened and seeds were removed. Blanched fruit was cooled and blended in mixer.

**Formulation details:** The following concentrations of fruit pulp were used.

F1= 10% concentration of fruit pulp on lassi basis.

F2= 20% concentration of fruit pulp on lassi basis.

F3= 30% concentration of fruit pulp on lassi basis.

**Table 1: Proportions of ingredients for Lassis blended with different fruit pulp**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variation | Fruit pulp (g) | Water (ml) | Curd (ml) | Sugar (g) |
| F1 | 10 | 34 | 44 | 15 |
| F2 | 20 | 24 | 44 | 15 |
| F3 | 30 | 14 | 44 | 15 |

**Note:** Different proportions of ingredients for different lassis blended with fruit pulp was represented in table 1.

**2.2.3.Sensory evaluation**

The developed standard and lassis blended with different concentration of fruit pulp were evaluated for sensory characteristics such as appearance, colour, consistency, flavour, taste and overall acceptability, and were served to semi trained panellists for sensory evaluation on a 9 point hedonic scale, with score 9 as excellent and score 1 as disliking. Sensory evaluation was carried out by 30 semi trained panel members [43].

**2.2.4. Analysis**

Moisture content and ash content of developed standard and different lassis blended with different concentration of fruit pulpwere carried out as per the method of AOAC [44]. Carbohydrates, protein,fibre and fat contents was carried out as per the method described by AOAC [45]. Vit-C by AOAC [46], total anti-oxidants content was carried out as per the method described by Anand *et al.,*[47]. Titratable acidity was carried out as per the method of AOCS [48]. Specific gravity is determined by using specific gravity bottle. pH was measured using microprocessor based digital pH meter (CYBER SCAN, MODEL PH 1500, EUTECH INSTRUMENTS, India). Microbiological analysis was carried according to APHA [49] and data were transformed into logarithms of the number of colony forming units (CFU/ml).

**2.2.5. Statistical analysis**

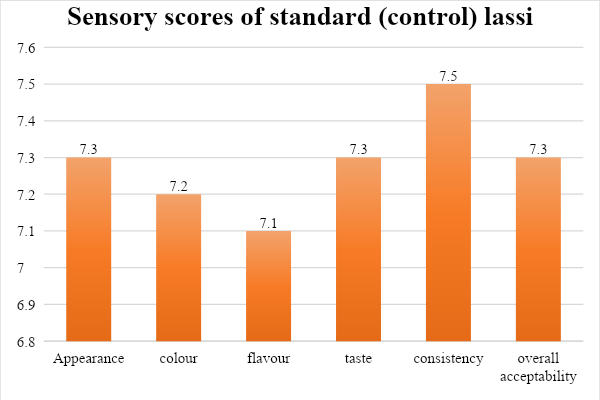
The data obtained for all the parameters was statistically analysed through student t-test to see the critical difference at 5% level of significance using CPCS1 software.

**3. RESULT AND DISCUSSION**

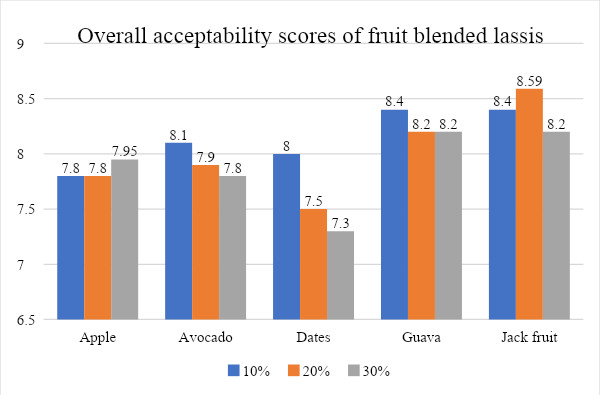
Good quality of lassi must have a creamy consistency, smooth texture, glossy sheen, white colour with yellowish tinge and a sweetish, rich aroma with mild to high acidic taste [50]. The results of the present study as well as relevant discussions have been presented under following sub heads, **Figure from 2a** to **2c** and **Table** from **2** to **5**. The different levels 0% (control), 10%, 20% and 30% fruit pulp was used for lassi formulation and evaluated for sensory parameters. Among 3 different formulations, for all 10 different fruit blended lassis, whichever had highest overall acceptability score was selected for further studies. The selected formulation from F1, F2 and F3 were analysed for nutritional, functional quality and microbial parameters.

**3.1. Standardization and development of Different fruit blended lassis**

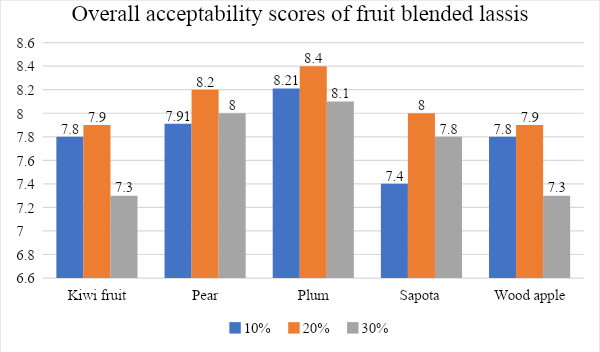
Different formulations of fruit blended lassis were prepared with addition of 10, 20 and 30% of pulps. All the formulations with standard (Control) were served to the semi trained panellist and evaluated for sensory parameters. The sensory evaluation is a scientific discipline that measures, analyses and interprets reactions to those characteristics of food and materials as they are perceived by the senses of vision, odour, taste, touch and hearing[51].Overall acceptability is the sum of different quality attributes which have a bearing on consumer perception towards the acceptance or rejection of a product.The finished product from all the concentrations were served to the group of 30 panel judges. The scores given for various parameters for the sensory evaluation were compiled, analysed and results are presented below. Standard (control) lassi was rated for organoleptic characteristics in the terms of appearance, colour, flavour, taste, consistency and overall acceptability on the 9 point hedonic scale. As shown in **Figure 2a**, standard (control) lassi was rated 7.3 for appearance, 7.2 for colour, 7.1 for flavour, 7.3 for taste, 7.5 for consistency and 7.3 for overall acceptability. The overall score of acceptability of apple lassi for the treatments F1, F2, andF3 were 7.80, 7.80 and 7.95 respectively. The highest overall acceptability score was observed in treatment F3 i.e. (7.95). The lowest overall acceptability score was found in treatment F1 and F2 (7.80) in apple lassi.As shown in the**Figure 2b** and **Figure 2c**,butter fruit, guava, dates and kiwifruits lassis are very much acceptable in F1formulation; and pear, plum, sapota, jackfruit and wood apple lassis are very much acceptable in F2. It was observed that formulationsF1,F2and F3 at par with each other. The different scientist studied on sensory attributes of lassi and give their parallel remarks to our findings specially by [52,53,54,55,56,57]in their respective work on different aspect.



**Figure 2a: Sensory scores of standard (control) lassi**



**Figure 2b: Overall acceptability of fruit blended lassis**



**Figure 2c: Overall acceptability of fruit blended lassis**

**3.2. Proximate Compositionof Developed Standard andFruitBlendedLassis**

Proximate composition of standard (Control) lassi and fruit blended lassis has been compiled in **Table 2**.Moisture content of standard (Control) lassi (81.42%) was quite high compared to other fruit blended lassis due to addition of water to the curd during preparation. Among all fruit based lassis, pear (77.34%) and plum lassis (77.81) had high moisture content, date lassi had low moisture content (70.62%). Carbohydrates content of standard lassi (15.44%) was low compared to other fruit blended lassis, among all fruit based lassis dates lassi had higher percentage of carbohydrates of about 21.56%. Among all the lassis, standard lassi (1.71%) had low protein content, wood apple lassi (3.42) had high protein content. Apple lassi (0.31%) contained low fat, avocado lassi contained (2.12%) high fat. Fibre was nil in standard lassi, fruits contain appreciable amount of fibre. For that reason, fibre content were found in fruit blended lassis. Among all the fruit blended lassis dates lassi (3.17%) had high fibre content plum (0.45%) had low fibre content. Ash content of all the lassis were below 0.6%. Similarresults were reported byUpadhyay*et al.,* [58] that,fat content of carrot juice fortified lassi was ranged from 2.31 to 3.81%, protein 2.82 to 3.53%,carbohydrate 13.16 to 16.85%, ash 0.68 to 0.8%. Ghule*et al.,* [59] reported that,fat content of strawberry pulp fortified lassi was ranged 3.11% to 3.25% protein 3.64 to 3.78, total sugar 13.92% to 16.29%, ash 0.73% to 0.85%. When compared with the literature, the results which obtained from the present study showed that there was significant difference in lassis were due to addition of different fruits at different concentration.

**Table 2. Proximate Compositionof Developed Standard and FruitBlendedLassis (n=3)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Sl No** | **Lassis** | **Moisture (%)** | **CHO\* (%)** | **Protein (%)** | **Fat (%)** | **Fibre (%)** | **Ash (%)** |
|  | **Standard (Control)** | 81.42±0.04 | 15.44±0.02 | 1.71±0.01 | 1.02±0.04 | Nil | 0.41±0.03 |
|  | **Apple** | 76.61±0.02 | 19.71±0.01 | 1.78±0.02 | 0.31±0.02 | 1.14±0.06 | 0.45±0.04 |
|  | **Avocado** | 75.95±0.07 | 18.24±0.03 | 2.51±0.14 | 2.12±0.05 | 0.66±0.04 | 0.52±0.01 |
|  | **Dates** | 70.62±0.01 | 21.56±0.04 | 2.21±0.08 | 2.01±0.08 | 3.17±0.19 | 0.43±0.02 |
|  | **Guava** | 74.97±0.03 | 18.55±0.09 | 2.13±0.03 | 1.72±0.01 | 2.21±0.06 | 0.42±0.14 |
|  | **Jackfruit** | 75.21±0.12 | 19.84±0.01 | 1.82±0.21 | 1.33±0.07 | 1.23±0.02 | 0.57±0.05 |
|  | **Kiwi fruit** | 76.28±0.10 | 18.71±0.13 | 2.30±0.02 | 1.41±0.08 | 0.91±0.04 | 0.39±0.08 |
|  | **Pear** | 77.34±0.08 | 18.15±0.04 | 1.76±0.08 | 1.32±0.03 | 1.01±0.15 | 0.42±0.02 |
|  | **Plum** | 77.81±0.13 | 18.39±0.01 | 1.92±0.06 | 1.21±0.01 | 0.45±0.14 | 0.22±0.01 |
|  | **Sapota** | 75.13±0.04 | 19.66±0.03 | 1.79±0.21 | 1.52±0.07 | 1.50±0.13 | 0.40±0.06 |
|  | **Woodapple** | 74.51±0.14 | 18.23±0.04 | 3.42±0.14 | 1.22±0.09 | 2.11±0.16 | 0.51±0.04 |

**3.3. Quality Parameters of Developed Standard and Fruit BlendedLassis**

Quality parameters of standard lassi and blended fruit lassis has been compiled in **Table 3.**Titrable acidity (% Lactic Acid) of the standard (control) lassi (0.31%) was low, kiwi fruit lassi (0.85%) had higher percentage of titrable acidity as compared to other fruit based lassis and standard, followed by wood apple (0.81%) and guava (0.76%). Apple lassi (3.5) had low pH,sapota had high pH (4.8). Specific gravity of the dates lassi and jackfruit lassi (1.070g/cm3) was high compared to other lassis. Guava lassi (0.099g/cm3) had low specific gravity. Upadhyay et al [58]reported that, Acidity (% Lactic Acid) of the carrot juice fortified lassiwas found to be 0.73% to 1.04% and pH values 3.98 to 4.43. Ghule et al [59]reported that, Acidity (% Lactic Acid) of the strawberry pulp fortified lassiwas found to be 0.90 to 1.02% and pH 4.13 to 4.31.

**Table 3: Quality Parameters of Developed Standard and FruitBlendedLassis (n=3)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sl No** | **Lassis** | **Titrable acidity (%)** | **pH** | **Specific gravity (g/cm3)** |
|  | **Standard (Control)** | 0.31±0.01 | 4.2±0.04 | 1.039±0.08 |
|  | **Apple** | 0.38±0.02 | 3.5±0.02 | 1.062±0.05 |
|  | **Avocado** | 0.51±0.07 | 4.5±0.03 | 1.046±0.03 |
|  | **Dates** | 0.41±0.05 | 4.3±0.01 | 1.070±0.09 |
|  | **Guava** | 0.76±0.02 | 4.0±0.04 | 0.099±0.02 |
|  | **Jackfruit** | 0.52±0.02 | 4.6±0.08 | 1.070±0.06 |
|  | **Kiwi fruit** | 0.85±0.11 | 3.9±0.03 | 1.051±0.08 |
|  | **Pear** | 0.68±0.09 | 3.9±0.09 | 1.051±0.02 |
|  | **Plum** | 0.64±0.12 | 3.6±0.07 | 1.061±0.01 |
|  | **Sapota** | 0.41±0.21 | 4.8±0.02 | 1.062±0.06 |
|  | **Woodapple** | 0.81±0.11 | 4.0±0.02 | 0.9463±0.09 |

**3.4. Antioxidant contents of Developed Standard and FruitBlendedLassis**

Most of the fruits are major sources of vitamin C, folic acid and dietary fibre [6].More than 90% of the ascorbic acid in the human diet comes from fruits and vegetables [7]. Standard (Control) lassi had 1.51mg of vitamin C for 100ml of lassi, as compared to fruit blended lassis, standard lassi was quite low in vitamin C. As shown in **Table 4**, fruit blended lassishad more vitamin C than standard lassi(Control). Ascorbic acid, as an antioxidant, is associated with a decreased risk of arteriosclerosis, cardiovascular diseases, and some forms of cancer [22].

As shown in **Table 4**, Antioxidant content of standard lassi was low compared to fruit blended lassis. The polyphenolic compounds (flavonoid) also have antioxidant characteristics and can account for some benefits associated with the consumption of fruits and vegetables [60].

**Table 4: Antioxidant content of Developed Standard and FruitBlendedLassis (n=3)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl. No** | **Lassis** | **Vit-C (mg/100ml)** | **Antioxidant (I%)** |
|  | **Standard** | 1.51±0.11 | 53.12±0.06 |
|  | **Apple** | 8.50±0.22 | 215.54±0.08 |
|  | **Avocado** | 6.21±0.05 | 188.17±0.09 |
|  | **Dates** | 1.12±0.09 | 65.87±0.07 |
|  | **Guava** | 146.12±0.03 | 290.34±0.05 |
|  | **Jackfruit** | 12.43±0.08 | 112.56±0.03 |
|  | **Kiwi fruit** | 45.76±0.19 | 121.09±0.02 |
|  | **Pear** | 3.21±0.08 | 148.32±0.08 |
|  | **Plum** | 6.71±0.14 | 321.21±0.05 |
|  | **Sapota** | 7.43±0.27 | 215.12±0.12 |
|  | **Woodapple** | 2.21±0.18 | 87.32±0.17 |

**3.5. Microbiological Evaluation of Developed Standard and Fruit BlendedLassis**

The microbiological quality of lassi depends upon the pre and post manufacturing, handling and packaging conditions. The lassi samples were subjected to bacteria, coliform, yeast and mold counts. As shown in the **Table 5,**different lassi sample showed different trend in microbial counts.Themicrobiological analysis clearly showed the sterilized condition of the product, Standard plate count was low in all lassi samples.Yeast and mould count were nil in standard, dates, jackfruit, kiwifruit, sapotaand wood apple lassis and remaining lassis had minimum microbial counts. Coliform was nil, which reflecting the safety of the product.

**Table 5: Microbiological Evaluation of Developed Standard and Blended Fruit Lassis (n=3)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Lassis** | **Standard plate count (CFU/ml)** | **Yeast and mould(CFU/ml)** | **Coliforms (CFU/ml)** |
| **Standard (Control)** | 10×101 | Nil | Nil |
| **Apple** | 21×101 | 2×101 | Nil |
| **Avocado** | 11×101 | 3×101 | Nil |
| **Dates** | 09×101 | Nil | Nil |
| **Guava** | 16×101 | 1×101 | Nil |
| **Jackfruit** | 08×101 | Nil | Nil |
| **Kiwi fruit** | 13×101 | Nil | Nil |
| **Pear** | 19×101 | 4×101 | Nil |
| **Plum** | 21×101 | 2×101 | Nil |
| **Sapota** | 17×101 | Nil | Nil |
| **Woodapple** | 12×101 | Nil | Nil |

**CONCLUSION:**

It can be concluded from the study that lassis prepared with different concentrations of fruit pulp were aimed to increase vitamin C and antioxidant content along with objective to improve sensory acceptability from consumers point of view. Therefore, best acceptable lassis can be prepared with 10% fruit pulp for avocado, guava, dates and kiwifruit, 20% fruit pulp for pear, plum, sapota, jackfruit and wood apple, 30% fruit pulp for apple lassi. All fruit blended lassis were having higher content of vitamin C and antioxidants. Also, being prepared from fruits, it is purely safe for public health and can be used as vitaminized and antioxidized food supplement as well.

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