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## Selection of strawberry form for preparation of low-fat spread

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### Abstract

Fat spread means a product in the form of water-in-oil emulsion, of an aqueous phase and a fat phase of edible oils and fats excluding animal body fats. In the preparation of low-fat dairy spreads, various fat sources are used including cream, butter or ghee. The utilization of ghee in the low-fat spread (LFS) will boon to the Indian Dairy Industry, as in excess milk production most of the butter fat is stored in the form of ghee and it is a most logical approach. However ghee is more prone to the oxidation and therefore deterioration may occur. To control oxidation synthetic anti-oxidant are generally used. At the same time synthetic anti-oxidant have several health hazards. Therefore here an attempt was made to develop protocol for utilization of strawberry in LFS with increased shelf-life. Fresh strawberry of navel variety was washed under running tap water followed by blanching, cutting in to pieces and subsequently dried in incubator at 55 °C for 16-18 hrs. These dry pieces crushed in electric grinder for 1 min., which was filtered through muslin cloth to get powder of strawberry. Strawberry was added in three different form viz., pulp form (SF1), Blanch powder form (SF2) and without blanch powder (SF3). Initially the form and level was optimized on the basis of sensory evaluation. The form of strawberry were optimized using CRD. It was found that the low fat spread prepared by the addition of the blanched powder of strawberry had obtained maximum scored for all the sensory qualities among other three forms under study. In trial the results showed that the color and appearance, body and texture, flavour, spreadability and overall acceptability score of low-fat spread was recorded maximum for low-fat spread prepared by using strawberry powder in blanched form. The validation of the prediction was done by actual observations recorded for sensory score. The optimized form had 7.90, 8.10, 7.65, 7.90 and 7.88 score for the color and appearance, body and texture, flavour, spreadability and overall acceptability respectively. Consumers as a whole liked the product 'moderately' to 'very much' with an average score of 7.70.

**Keywords:** Low-fat spread (LFS), strawberry, sensory evaluation

### Introduction

The fat in milk is primary to provide a source of energy to the new born baby. Dairy products, particularly higher-fat dairy products are considered significant sources of energy in the diet of vegetarian population too (Feeney *et al.* 2017) [6]. The milk fat products could be divided into several categories according to their fat contents, including anhydrous milk fat products, butter, cream and dairy fat spreads. Recently variety of dairy and non-dairy spreads is available on the customers door. These spreads may be to increase the content of unsaturated fatty acids for improvement of spreadability at low temperatures (Lee *et al.* 2018) [14].

Spreads are the products harmonizing with the idea of healthy nutrition. At the same time they have good taste and flavor as well as very good spreadability at refrigerator temperature and retain its stand up property even at high ambient temperature (Dostalova 2003) [5]. Spreads have low caloric content than butter and blends easily with other foods for convenience in cookery and serving. Both the dietary and convenience requirements of the consumer have been required by table spreads. Commercial table spreads now exists that contain fat level ranging from a high of 80 per cent all the way down to 0 per cent. Products resembling margarine containing less than 80 per cent fat are usually called spreads. As per regulations in some countries, only products containing less than 80 per cent but more than 40 per cent fat, 40-70 per cent fat, 62-80 per cent fat, or less than 75 per cent fat are labeled as spreads. Products with 60-80 per cent fat or with 41-60 per cent fat are 'reduced-fat' spreads and products containing less than 40 per cent are referred to as 'low-fat' spreads. The term 'very low-fat' spreads is used for spreads of 5-15 per cent fat and even less.

The spreads with extremely low-fat content are sometime called 'Ultra low-fat' spreads. Low-fat spread, generally contain 30-50 per cent moisture, 30-50 per cent fat and 8-12 per cent solids-not-fat (Dostalova 2003) [5]. It can be manufactured from different types of fat (*viz.* butterfat, vegetable fat or other animal fat), protein (milk proteins e.g. skim milk, buttermilk, whey or their concentrated forms, sodium caseinate, calcium reduced skim milk powder, ultrafiltered protein concentrate, whey protein concentrate etc.) and using additives like stabilizers, emulsifiers, plasticizers, emulsifying salts, vitamins, colorants and flavoring material. Considerable efforts have been made in India for development of fat spreads of dairy and non-dairy type using a variety of ingredients *viz.* butter, butter oil, cream, paneer, channa, cheese, vegetable fat and ghee (Patange 2006) [23].

The exploitation of ghee in the manufacture of low fat spread is the need of today's dairy industry due to its easy availability and better shelf life at ambient temperature. (Patange *et al.* 2015) [24] utilized ghee in general as a source of fat in the manufacture of low fat spread.

Ghee is a fat rich dairy product widely used in India since time immemorial. It has been an integral part of our culture. Ancient Sanskrit literature describes Ghee (Ghrita) as the food fit for Gods and commodity of enormous value. Nutritionally, ghee is a superior dairy product. Apart from a concentrated source of energy, it is also a good source of essential fatty acids, fat soluble vitamins like A, D, E & K and it also forms essential structural components of the cell membrane. With regards to digestibility, absorption and growth, it has been found that ghee lies in the completely digestible class of fat. It can therefore be an important dietary constituent for the patients having diseases of stomach, intestinal tract, liver, kidney, gall bladder (Toyabhai, 2012) [28].

Despite of its numerous health benefits, over the past few years, ghee has received adverse publicity due to its cholesterol and saturated fatty acid contents. Both have been negatively implicated as perpetrators of arteriosclerosis (Sharma *et al.*, 2010) [25] hence hypertension. From the nutritionist's point of view, the removal of a whole food group from the diet, such as ghee simply to avoid cholesterol and saturated fatty acids is illogical and creates more difficulty for Indian people where ghee plays an important role in their diet (Parmar and Khamrui, 2017) [22].

Consumption of phyto-chemical-rich foods such as fruits, vegetables are associated with a reduced risk of diseases mediated by oxidative stress and inflammation such as certain cancers, atherosclerosis and neurodegenerative diseases (Larsson *et al.*, 2006) [13]. Berry fruits are reported to contain a wide variety of phenolics including hydroxybenzoic and hydroxycinnamic acid derivatives, anthocyanins, flavonols, flavanols, condensed tannins (proanthocyanidins) and hydrolyzable tannins (Machiex *et al.* 1990) [16]. Strawberry is an important fruit of family Rosaceae. Occupies an important place among the small fruit plants and is grown throughout the world. Deep red in colour with unique shape, highly perishable fruit has a pleasant flavour. It is rich in vitamin C, sugar, organic acids anthocyanin, phosphorus, iron, other minerals, vitamins, etc. and its desirable flavour is characterized as fruity, sweet and tart. It is utilized for the production of purees, juice concentrate, juice, jams, preserves and rose red wine, (Sharma *et al.*, 2009) [26] strawberries (*Fragaria x ananassa*) is one of the most popular fruit worldwide, with the high unique and desirable flavour. The

main characteristics associated with the quality of ripe strawberries are their texture, and presence volatile compounds (Jiawei *et al.*, 2019) [10] strawberries are widely known for their potential health benefits due to their high fiber, potassium, vitamin C and folate contents. Strawberries are also a very good source of blood sugar-regulating dietary fibers (pectins, celluloses, etc.) and thyroid health-promoting iodine. Strawberry fruits are rich in sugars (mainly glucose and fructose, with smaller amounts of sucrose) and acids. Strawberry is good source vitamin C. It has been proved that vitamin C and phenolic compounds contribute to antioxidant capacity of fruits, as they act as oxygen radical scavengers and may exhibit beneficial health effects (Yildiz *et al.*, 2014) [29] Strawberries are rich in potassium (the most abundant mineral), calcium and magnesium. They are also a good source of folate, omega-3 fatty acids, vitamin B6, and vitamin K, as well as energy-promoting vitamins B2 and B5 (Milivojevic *et al.*, 2010) [19].

However, ripe strawberry is highly perishable mainly because of the smooth texture, high softening and respiration rate, as well as being proved to fungal attacks and off flavour development (Lara *et al.* 2004) [12]. Therefore it needs to utilize properly in different food items including low-fat spread.

Considering the nutritional, therapeutic and antioxidant properties of strawberry and use of ghee in low fat spread preparation, it is planned to use the strawberry in the preparation of ghee based low-fat spread

## Materials and Methods

Fresh cow milk ghee was obtained from the local market of Kolhapur city. Spray-dried skimmed milk powder (SMP) was obtained from Kolhapur District Milk Producer Union Limited (Gokul), Kolhapur. Navel variety of strawberry fruit was procured from the local market of Kolhapur City. Carragenan-Type II Iota-carrageenan M/S (Hi Media) was used as stabilizer to make the emulsion stabilized. Sorbitol obtained from M/S Qualigens Fine Chemical, Mumbai and was

used as plasticizer to improve the spreadability of the low fat spread. Polyoxyethylenesorbitanmonoleate (Tween-80) of (S.D Fine-chem. Ltd) emulsifier was used to make the emulsion strong. Iodized common salt was procured from the local market of Kolhapur city. Citric acid was purchased from M/S. Qualigens Fine chemical, Mumbai used for maintaining the pH of low fat spread.

## Methodology

### Preparation of forms of strawberry fruits

#### Preparation of Pulp

Strawberry pulp was prepared as per the procedure described by (Bishnoi *et al.* 2016) [2]. Uniform red colour, medium size healthy fruits were selected for the preparation of pulp. The fruit sepals were removed manually and crushed with the help of Pulp-Homogenizer mixture. The pulp of was then packed in sterilized glass bottles and pasteurized at 100°C temperature for 15 min. Then homogenized pulp was passed through the 1 mm stainless steel sieve. The pulp was processed stored by for longer period as per the procedure described by (Bishnoi *et al.* 2016) [2].

#### Preparation of powder

The Strawberry were procured from local market of Kolhapur and brought to Laboratory of Department of Animal

Husbandry and Dairy Science, RCSI College of Agriculture, Kolhapur. The strawberry fruits were washed under running potable tap water. Then, fruits were blanched in boiling water for 3 to 5 minutes. After blanching the fruits were cut into four pieces and were kept for drying at 55 °C for 18 hours (Olubunmi *et al.* 2013) [20]. The dried strawberry fruit pieces were grinded into powder using a kitchen mixer blender. The powder obtained was passed through 1mm stainless steel sieve. The sieved strawberry powder was sealed in plastic bags, at room temperature for further use. Similar process was carried out for without blanched strawberry fruits except boiling into the water for 3-5 minutes.

### Preparation of low-fat spread using cow milk ghee added with strawberry

Low-fat spread from cow milk ghee was prepared as per protocol developed by (Patange, 2006) [23] in planetary Mixer. The procedure involves separate preparation and tempering of fat and serum phases before blending and emulsifying them. For preparation of fat phase ghee was heated up to 50 °C and then added with the emulsifier. It was then heated (in a water-bath) to 70 °C before being rapidly cooled to 20 °C (rate of cooling, 12 °C/min) with continuous agitation in a chilled water-bath (2.5 °C ± 1 °C) and subsequently to 5°C by quiescent holding in a refrigerator for an overnight period. The cooled fat phase was then tempered to the blending temperature of 25°C ± 1 °C by holding in room temperature for 6 h before use.

Skimmed milk powder as a source of MSNF was dispersed in water together with soluble ingredients followed by mixing with an electric blender, preheating (55 °C), filtration (double-fold muslin cloth), pasteurization (72 °C for 15 - 20 sec), cooling in an ice water-bath to 20 °C, Before transferring in the aqueous phase in refrigerator it was added with strawberry in different forms as per the treatments. The aqueous phase was remained kept for overnight period of time at refrigerator temperature (5 °C). The selected variety, form and quantity of strawberry was added in the aqueous phase as per treatments. Finally, when required this aqueous phase was acidulated using a dilute citric acid to the desired pH 5.2 (30 min before blending) and warmed it to blending temperature.

The tempered fat phase was transferred to the bowl of planetary mixer and creaming was carried out using the flat beater attachment of the mixer for 30 sec at 'medium' speed. The serum phase was added in three equal installments. Blending was carried out after each addition of the serum phase using medium speed for 30 sec. The spreads was packed in 75 gm in plastic cups and closed with lids before being transferred to refrigerator (5 °C).

### Process optimization

#### Selection of forms of strawberry in the ghee based LFS

The strawberry was add in the product either in pulp form or in powder form and an attempt was made to prepare a ghee based low fat spread. All the forms were added in aqueous phase after pasteurization stage. The rate of addition of strawberry in different form was decided on the basis of

preliminary trials. The treatment were as follows, LFS added without strawberry (SF<sub>0</sub>), LFS added with strawberry in pulp form @4% (SF<sub>1</sub>), LFS added with strawberry in with blanched powder form @4%(SF<sub>2</sub>), LFS added with strawberry in without blanched form @4%(SF<sub>3</sub>). The product were evaluated for sensory qualities and one best was selected.

### Sensory evaluation

Sensory evaluation of strawberry added ghee based low-fat spread samples were carried out by a semi-trained panel of judges from the staff of the Division of Animal Husbandry and Dairy Science RCSI college of Agriculture, Kolhapur, by using 9-point Hedonic scale(Appendix-I) as described by (Hue, 1993) [9]. Spreadability was assessed by the panelists using a piece of bread slice to spread the product at uniform experimental temperature 5 ± 1 °C.

### Statistical Analysis

The Data generated during the course of investigation were analyzed using completely randomized design (CRD) technique with five replications (Snedecor and Cochran, 1967)

### Results

#### Effect of strawberry Form on sensory qualities (score\*) of low- fat spread

##### Effect on color and appearance score

Color and appearance gives the first impression about any food product and thus plays an important role in deciding the consumer's acceptability of the same. From the Table it is clear that the color and appearance score of low fat spread was significantly (P<0.05) affected by the forms of strawberry. The color and appearance score for SF<sub>0</sub>, SF<sub>1</sub>, SF<sub>2</sub> and SF<sub>3</sub> were 7.10 ±0.07, 6.50±0.04, 7.90±0.02 and 7.75±0.02, respectively. The maximum score (7.90±0.02) was obtained to low fat spread containing strawberry powder in blanched form. It was found that there is retention of more color in blanching treatment hence the score is more. (Lin *et al.* 2007) [15] reported that the blanching treatment significantly affected the texture and color of processed green bean and endive that helps to improve the texture and color of sterilized green bean. However the effect of blancher and non-blancher treatment were at par with each other. The panel of judged comments that the low fat spread containing blanching powder had pinkish colour where sample containing pulp and without blanch powder had light pinkish colour. Pigments and color of strawberry were best retained after heat processing Holzwarth *et al.* (2011) [8] Bajwa *et al.* (2003) [11] also studied the effect of addition of strawberry pulp on colour and appearance score of Ice-cream at different concentration and they found that strawberry found to be significant help in improvement in the appearance score of ice cream. The colour and appearance score with SF<sub>1</sub> was presence of leak water with too most appearance observed to in case of SF<sub>1</sub>hence score may be lowest.

**Table 1:** Effect of strawberry Form on sensory qualities (score\*) of low- fat spread

Treatment	Sensory Attributes				
	Color and appearance	Body and texture	Flavour	Spreadability	Overall acceptability
SF <sub>0</sub>	7.10 <sup>b</sup> ±0.07	7.81 <sup>b</sup> ±0.04	7.00 <sup>a</sup> ±0.04	8.00 <sup>b</sup> ±0.02	7.48 <sup>b</sup> ±0.01
SF <sub>1</sub>	6.50 <sup>a</sup> ±0.04	7.17 <sup>a</sup> ±0.03	7.25 <sup>b</sup> ±0.04	7.05 <sup>a</sup> ±0.07	7.02 <sup>a</sup> ±0.03
SF <sub>2</sub>	7.90 <sup>c</sup> ±0.02	8.10 <sup>c</sup> ±0.02	7.65 <sup>d</sup> ±0.04	7.90 <sup>b</sup> ±0.02	7.88 <sup>c</sup> ±0.02

SF <sub>3</sub>	7.75 <sup>c</sup> ±0.02	7.98 <sup>b</sup> ± 0.05	7.50 <sup>c</sup> ±0.04	7.90 <sup>b</sup> ±0.05	7.79 <sup>c</sup> ±0.02
S.Em	0.06	0.05	0.06	0.05	0.03
Cd ( <i>p</i> < 0.05)	0.15	0.18	0.13	0.13	0.10

\*Means of four replications within row followed by the same letter are not significantly different at *p*< 0.05

### Effect on body and texture score

Body and texture is the second most important characteristics that determine the consumer's acceptability of any food product. The body and texture score of LFS as affected by the forms of strawberry was indicated that there was more or less significantly different. The body and texture score was ranged from 7.17±0.03 to 8.10±0.02. The maximum score recorded for treatment SF<sub>2</sub> and minimum score recorded for treatment SF<sub>1</sub>. The comments of judge on LFS prepared by addition of strawberry in the form of pulp had too soft body and not firm texture. It may also because of more percentage moisture in the product. Paradhi *et al.* (2014) [21] studied on the fortified lassi using finger millet flour at 2.3 and 4% concentration increase the score addition of flour at 3% then decrease body and texture. Lin *et al.* (2007) [15] reported that the blanching treatment in blanching solution containing calcium and zinc cation significantly affected the texture and color of processed green bean and endive that helps to improve the texture and color of sterilized green bean.

### Effect on flavour score

Flavour of any food product is perhaps the most important and basic sensory perception that appeals to the consumer and affects its acceptability. The flavour score of LFS was also affected due to the various forms of strawberry and it was significant (*P*< 0.05). The maximum score (7.65±0.04) for flavour recorded for LFS prepared by using blanch powder, whereas minimum score (7.00±0.04) LFS prepared without strawberry. The flavour score for SF<sub>0</sub>, SF<sub>1</sub>, SF<sub>2</sub>, and SF<sub>3</sub> were 7.00±0.04, 7.25±0.04, 7.65±0.04, 7.50±0.04, respectively. The lowest score for SF<sub>0</sub> may be because of pronounced flavour of ghee which is not expected in LFS. Bullock (1996) reported that low-fat spreads of good sensory properties comparable to the full spreads could be developed with the use of calcium reduced SMP. Madsen (1990) [17] reported that addition of demineralized whey powder, as protein source in the spread can enhance the emulsion properties and improve the flavour release qualities. Similar findings reported by Meenakshi *et al.* (2018) [18] formulated value added probiotic fruit yoghurt by addition of banana, papaya and sapota pulp at 5 to 15% concentration and which score was 8.0.

### Effect on spreadability score

Spreadability is subjective term related to how easy a sample uniformly distributed over a surface. The most appreciable feature of low-fat spread is that they are spreadable even at low temperature. Spreadability score of low fat spread ranged from 8.00±0.02 to 7.05±0.07. The lowest score was obtained for the low spread contained strawberry pulp (SF<sub>1</sub>) while the highest score was obtained for the low fat spread (control) i.e. (SF<sub>0</sub>). Kharb (2007) [11] observed a decrease in spreadability of table spread with increase in the level of milk protein and dietary fiber content. The spread ability score for SF<sub>0</sub>, SF<sub>1</sub>, SF<sub>2</sub> and SF<sub>3</sub> were 8.00±0.02, 7.05±0.07, 7.90±0.02, 7.90±0.05 respectively. Bajwa *et al.* (2003) [1] prepared strawberry pulp added Ice-cream at rate of 5 and 10% and which score had 7.80 moisture content was more so that the good spreadability than powder of fruit. As reported earlier the product added with pulp had too smooth body and same behavior is exerted

in spreadability score. The report of Do *et al.* (2016) [4] highly correlate with present study and reported that the LFS formulated with rice starch and maltodextron did not yield enough stability and consistency.

### Effect on overall acceptability score

The data pertaining to forms of strawberry on overall acceptability are depicted in Table and fig 5. It was observed that overall acceptability score was significantly (*p*< 0.05) affected by the forms of strawberry. The overall acceptability score SF<sub>0</sub>, SF<sub>1</sub>, SF<sub>2</sub> and SF<sub>3</sub> were 7.48±0.01, 7.02±0.03, 7.88±0.02 and 7.79±0.02 respectively. The maximum score for overall acceptability was recorded to the spread of SF<sub>2</sub> (score 7.88±0.02). The minimum score for overall acceptability was recorded to the spread of SF<sub>1</sub> (score 7.02±0.03). From the above results it clearly seen that the low-fat spread prepared by the addition of the blanch powder had maximum score for the all the sensory parameters over the two forms under study. Ghule *et al.* (2015) [7] reported that the strawberry fortified lassi by adding 5% strawberry pulp had overall acceptability score 7.90 to 8.00 which is in range of overall acceptability score of LFS. Hence blanch powder used for further optimization experiment.

From the discussion of table it is concluded that, use of strawberry in blanched powder form result in the maximum sensory perception.

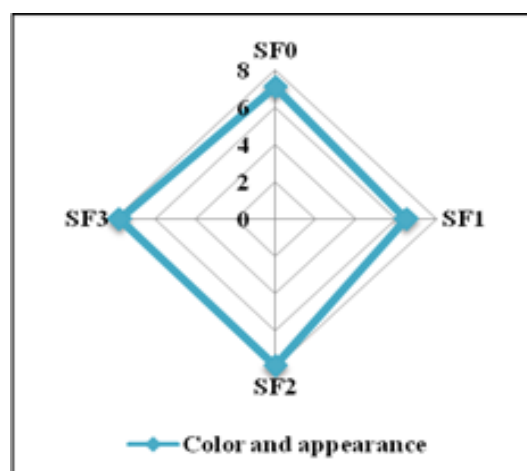


Fig 1: Effect of Strawberry Form on colour and appearance of LFS

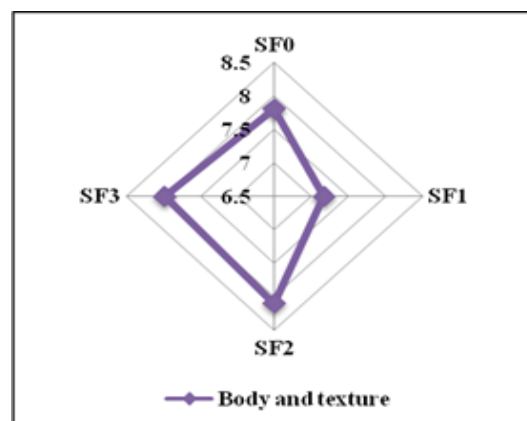


Fig 2: Effect of Strawberry Form on body and texture of LFS

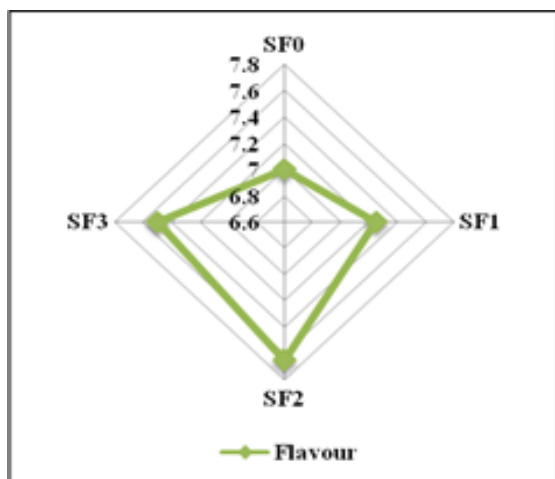


Fig 3: Effect of Strawberry Form on flavour of LFS

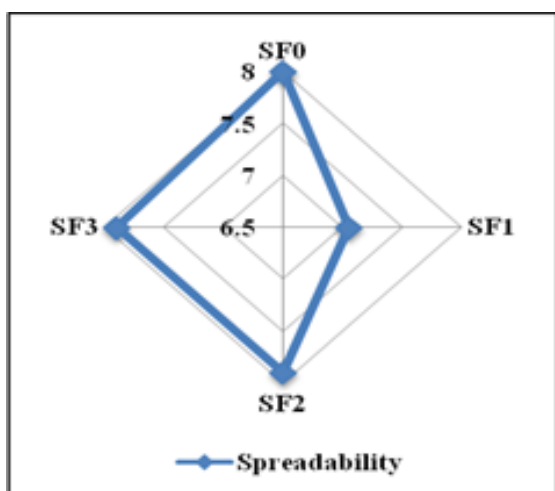


Fig 4: Effect of Strawberry Form on spreadability of LFS

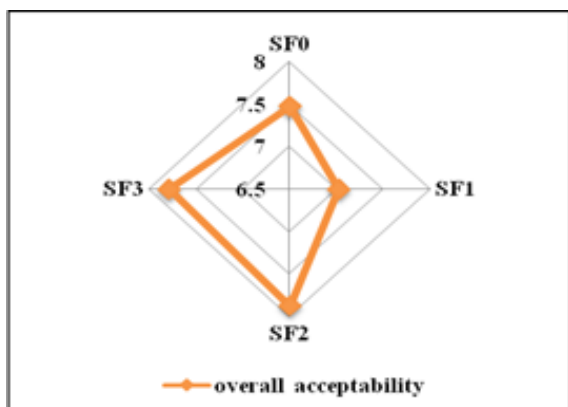


Fig 5: Effect of Strawberry Form on overall acceptability of LFS

### Conclusions

Results of the present study indicated that the resultant product was analyzed for sensory parameters of colour and appearance, flavour, body and texture, spreadability and overall acceptability. From this study it was summarized that low fat spread prepared by addition of strawberry in blanched powder form was most acceptable. The colour and appearance score for SF<sub>0</sub>, SF<sub>1</sub>, SF<sub>2</sub> and SF<sub>3</sub> were  $7.10 \pm 0.07$ ,  $6.50 \pm 0.04$ ,  $7.90 \pm 0.02$  and  $7.75 \pm 0.02$ , respectively. The body and texture score of LFS as affected by the forms of strawberry was indicated that there was more or less significantly different. The body and texture score was ranged from  $7.17 \pm 0.03$  to

$8.10 \pm 0.02$ . The comments of judge on LFS prepared by addition of strawberry in the form of pulp had too soft body and not firm texture the flavour score of LFS was also affected due to the various forms of strawberry and it was significant ( $P < 0.05$ ). The lowest score for SF<sub>0</sub> may be because of pronounced flavour of ghee which is not expected in LFS. Spreadability score of low fat spread ranged from  $8.00 \pm 0.02$  to  $7.05 \pm 0.07$ . The lowest score was obtained for the low spread contained strawberry pulp (SF<sub>1</sub>) while the highest score was obtained for the low fat spread (control) i.e. (SF<sub>0</sub>). The overall acceptability score highest was obtained for the low fat spread prepared from the addition of blanched strawberry powder (SF<sub>2</sub>).

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