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## Process optimization for low fat spread added with strawberry

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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. The various varieties of strawberry was added in low-fat spread viz., Sweet sensation (SV1), Camarosa (SV2), Navel (SV3) and R1(SV4). Initially the variety was optimized on the basis of sensory evaluation. It was found that the low fat spread prepared by the addition of the Navel variety of blanched powder of strawberry had obtained maximum scored for all the sensory qualities among other three varieties 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 of Navel variety. The validation of the prediction was done by actual observations recorded for sensory score. The optimized form had 8.14, 7.75, 8.10, 7.80 and 7.94 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, strawberry, variety, 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) [10]. 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)<sup>[15]</sup>.

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)<sup>[16]</sup> 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)<sup>[19]</sup>.

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)<sup>[17]</sup> 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)<sup>[14]</sup>.

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)<sup>[9]</sup>. 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)<sup>[11]</sup>. 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) 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)<sup>[7]</sup> 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)<sup>[21]</sup> 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)<sup>[12]</sup>.

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)<sup>[18]</sup>. 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. Four varieties of strawberry such as Sweet Sensation, Camarosa, Navel and R<sub>1</sub> fruits were 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. Poly- oxyethylene sorbitan monooleate (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 powder

The Strawberry were procured from local market of Kolhapur and brought to Laboratory of Department of Animal Husbandry and Dairy Science, RCSM 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)<sup>[13]</sup>. 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.

### 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)<sup>[15]</sup> 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 ( $2.5^{\circ}\text{C} \pm 1^{\circ}\text{C}$ ) and subsequently to  $5^{\circ}\text{C}$  by quiescent holding in a refrigerator for an overnight period. The cooled fat phase was then tempered to the blending temperature of  $25^{\circ}\text{C} \pm 1^{\circ}\text{C}$  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 ( $55^{\circ}\text{C}$ ), filtration (double-fold muslin cloth), pasteurization ( $72^{\circ}\text{C}$  for 15 - 20 sec), cooling in an ice water-bath to  $20^{\circ}\text{C}$ . 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 ( $5^{\circ}\text{C}$ ). 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 were packed in 75gm in plastic cups and closed with lids before being transferred to refrigerator ( $5^{\circ}\text{C}$ ).

#### Selection of strawberry variety in the preparation of ghee based low fat spread

The different variety of strawberry such as Sweet sensation, Camarosa, Navel and R1 were washed under running tap water. The blanched powder of strawberry fruits was prepared as per the procedure described. The low-fat spread was prepared by the addition of powder @ 4 per cent of the product. The treatment were as follows:

SV<sub>0</sub>: LFS with Sweet Sensation variety of strawberry

SV<sub>1</sub>: LFS with Camarosa variety of strawberry

SV<sub>2</sub>: LFS with Navel variety of strawberry

SV<sub>3</sub>: LFS with R1 variety of strawberry

Samples 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) <sup>[10]</sup>.

#### 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).

#### Result and discussion

##### Selection of Strawberry Variety for the Preparation of Low-fat Spread

It is found that there are number of cultivars of strawberry grown in Kolhapur region. Based on the sources four strawberry varieties viz. Camarosa, Navel, Sweet sensation, R<sub>1</sub> were procured. The fruits of these variety were converted into fine blanched powder and used in the preparation Low-Fat

Spread. The products were evaluated for sensory qualities. The treatments include control i.e. LFS with powder of sweet sensation variety (SV<sub>1</sub>), LFS with powder of camarosa variety (SV<sub>2</sub>), LFS with powder of navel variety (SV<sub>3</sub>) and LFS with powder of R<sub>1</sub> variety. The result generated are present in Table and fig1 to 5.

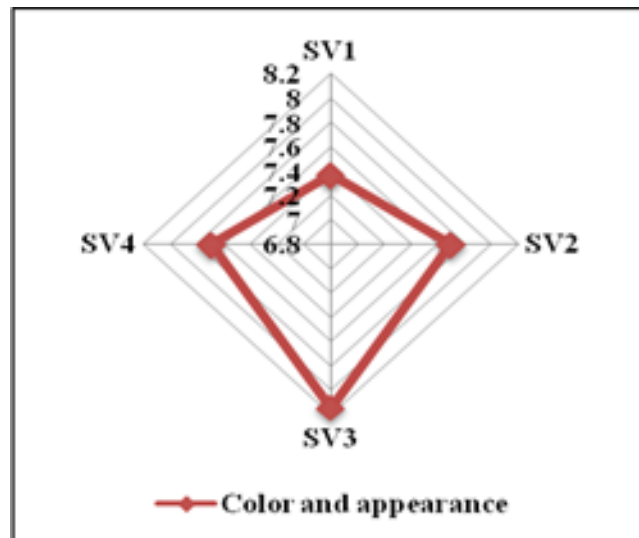


Fig 1: Effect of Strawberry variety on colour and appearance of LFS

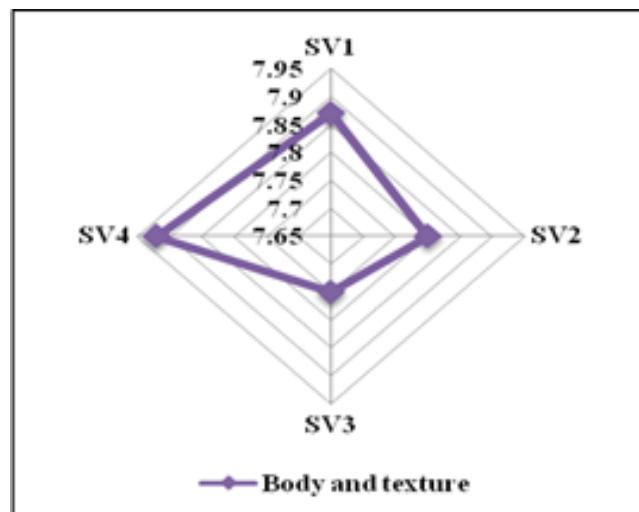


Fig 2: Effect of Strawberry variety on body and texture of LFS

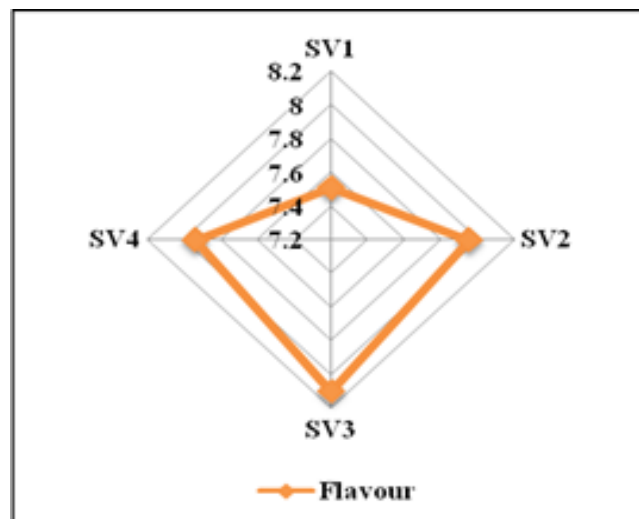


Fig 3: Effect of Strawberry variety on flavour of LFS

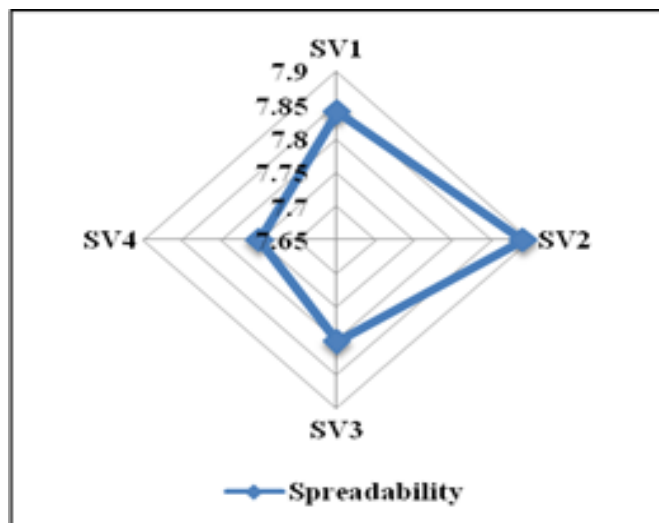


Fig 4: Effect of Strawberry variety on spreadability of LFS

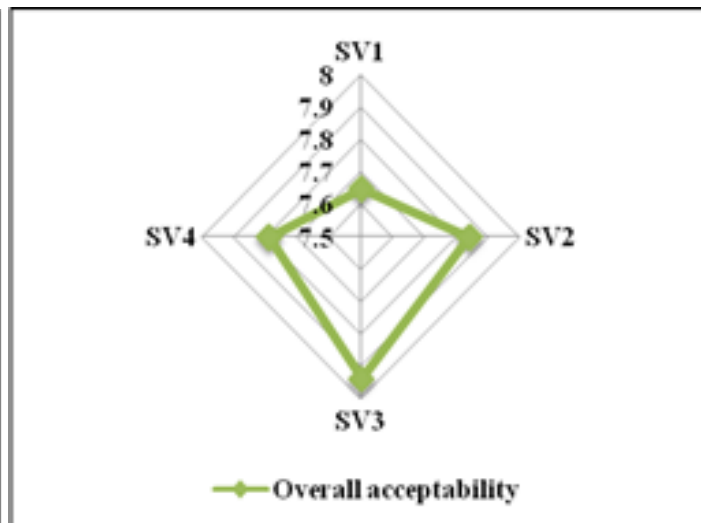


Fig 5: Effect of Strawberry variety on overall acceptability of LFS

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

Treatment	Sensory attributes				
	Color and appearance	Body and texture	Flavour	Spreadability	Overall acceptability
SV <sub>1</sub>	7.37 <sup>a</sup> ±0.05	7.87±0.04	7.51 <sup>a</sup> ±0.05	7.84±0.02	7.65 <sup>a</sup> ±0.02
SV <sub>2</sub>	7.70 <sup>b</sup> ±0.05	7.80±0.04	7.95 <sup>b</sup> ±0.05	7.89±0.06	7.84 <sup>a</sup> ±0.05
SV <sub>3</sub>	8.14 <sup>c</sup> ±0.04	7.75±0.05	8.10 <sup>b</sup> ±0.05	7.80±0.05	7.94 <sup>ab</sup> ±0.03
SV <sub>4</sub>	7.69 <sup>b</sup> ±0.07	7.92±0.08	7.94 <sup>b</sup> ±0.02	7.75±0.03	7.79 <sup>a</sup> ±0.04
Cd(P<0.05)	0.28	NS	0.41	NS	0.27
sem	0.10	0.13	0.14	0.13	0.0

\*Mean ± SE of five replications within column followed by same letter are non-significantly different at  $p < 0.05$  NS=Non significant

#### Effect of strawberry variety on color and appearance score of LFS

It is clear from the data presented that the effect of powder of different strawberry variety was significant ( $P < 0.05$ ) on colour and appearance score of low fat spread. The low fat spread prepared from powder of navel variety score highest (8.14) for colour and appearance and which was ( $p < 0.05$ ) significantly greater than the others. The colour and appearance score of low fat spread prepared from powder of sweet sensation, Camarosa, navel and R<sub>1</sub> variety was 7.37, 7.70, 8.14, and 7.69, respectively. The variation in colour and appearance score might be because of the presence of anthocyanin pigment in the strawberry as reported by Sharma *et al.* (2006) [18].

Yoshida *et al.* (2002) [22] reported that anthocyanins are the major pigment of strawberry fruit, among which, pelargonidin 3- glucoside (PG) is predominant, followed by cyaniding 3- glucoside(CG) which mainly responsible for the development of colour in strawberry.

#### Effect of strawberry variety on body and texture score of LFS

The body and texture score of low fat spread as affected by the varieties of strawberry was indicated that there was more or less similar score and statistically it was non-significant. The body and texture score was ranged from 7.92±0.08 to 7.75±0.05. The maximum score recorded for treatment SV<sub>4</sub> and minimum score recorded SV<sub>3</sub>. Slight variation in body and texture score of LFS prepared from different varieties may be chemical inherent of strawberry fruits not improvement in the body and texture score by the addition of additives was reported by Do *et al.* (2016) [4].

#### Effect of strawberry variety on flavour score of LFS

The flavour score of low-fat spread was also affected due to

the varieties of strawberry and it was significant ( $P < 0.05$ ). The maximum score was (8.10±0.05) for flavour was recorded for low- fat spread prepared by using navel variety, whereas the minimum score was recorded (7.51±0.05) for low-fat spread with sweet sensation variety. strawberry volatile compounds consist of furanones, such as 2,5- dimethyl- 4- hydroxy- 3(2H)- furanone and 4- methoxy- 2,5- dimethyl- 3(2H)- furanone; esters including ethyl butanoate, ethyl hexanoate, methyl butanoate, and methyl hexanoate; sulfur compounds such as methanethiol, and terpenoids including linalool and nerolidol reported by Yan *et al.* (2018) [20].

#### Effect of strawberry variety on spreadability score of LFS

The effect of variety on the spreadability (score) of strawberry added low- fat Spread was depicted in the Table and fig 4. The data revealed that the spreadability score was non-significantly ( $P < 0.05$ ) affected by the variety of strawberry. The spreadability score for SV<sub>1</sub>, SV<sub>2</sub>, SV<sub>3</sub> and SV<sub>4</sub> were 7.84±0.02, 7.89±0.06, 7.80±0.05, 7.75±0.03 respectively. Bhardwaj *et al.* (2017) [1] reported that addition of pomegranate peel extract in cream based fat spread has high moisture content and with higher water activity hence there was non-significant difference occurs in the various concentration of strawberry pulp. The non-significant variety of strawberry on spreadability may be because of all the factor had more or less same physico-chemical property. The score more than in all the spread indicated.

#### Effect of strawberry variety on overall acceptability score of LFS

The effect of variety of strawberry powder on overall acceptability score was depicted in Table and fig 5. The data revealed that the overall acceptability score was significantly ( $P < 0.05$ ) affected by the variety of the strawberry. The

overall acceptability score for SV<sub>1</sub>, SV<sub>2</sub>, SV<sub>3</sub> and SV<sub>4</sub> were 7.65±0.02, 7.84±0.05, 7.94±0.03, 7.79±0.04, respectively. From the above results it clearly seen that the Low-fat spread prepared by the addition of the powder of navel variety had maximum score for the all the sensory parameters over the three varieties under study.

### Conclusions

Result of present study indicated that low fat spread prepared from powder of navel variety score highest (8.14) for colour and appearance and which was ( $p < 0.05$ ) significantly greater than the others. The body and texture score of low fat spread as affected by the varieties of strawberry was indicated that there was more or less similar score and statistically it was non-significant. The flavour score of low-fat spread was also affected due to the varieties of strawberry and it was significant ( $P < 0.05$ ). The data revealed that the spreadability score was non-significantly ( $P < 0.05$ ) affected by the variety of strawberry. The data revealed that the overall acceptability score was significantly ( $P < 0.05$ ) affected by the variety of strawberry.

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