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Assessment of nutritional and microbial quality of dragon-aonla blended fruit spread

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ABSTRACT

Dragon fruit is highly nutritious but hasn't been widely accepted by consumers due to its poor taste. Its taste can be improved through value addition and thus dragon fruit could become a common household item. Blending dragon fruit pulp with Aonla pulp presents an opportunity to create a balanced health product that is high in both sensory and nutritional quality. The present investigation was carried out to prepare fruit spread, a fruit confectionery prepared by combining sugar, pectin, and acid with blended pulp of dragon fruit and aonla fruit. The storage studies of mixed fruit spread packed in glass jar showed significant changes in physico-chemical properties during three months of storage. Total soluble solid, total sugars, reducing sugars and titratable acidity increased significantly from 60.00-61.39°B, 41.04-42.50%, 17.24-18.33% and 0.671-0.757%, respectively, while moisture, ash, phosphorus and iron content decreased significantly from 29.58-27.93%, 0.689-0.461%,13.85-13.43 mg/100g and 1.095-0.771 mg/100 g, respectively in blended fruit spread during storage. Ascorbic acid content was maximum (71.08 mg/100g) in blended spread containing 50%aonlapulp, while betacyanin content was maximum (15.45 mg/100g) in spread with 100%dragon fruit content. All the samples were under safe limits for three months of storage. The treatment containing 60% dragon fruit and 40% aonla fruit scored high colour, texture, taste, mouthfeel, and overall acceptability rating. The dragon and Aonla fruits possess good nutritional properties which could be utilized for the large scale production at industrial level.

Keywords: *Aonla, Betacyanin, Dragon fruit, Spread, Nutritional parameters, Microbial quality, Sensory parameters.*

INTRODUCTION

Fruits rank high among food choices owing to their nutritional value. It's an incredible present from nature to humanity, fruits are actually life-enhancing medications that are rich in vitamins, minerals, antioxidants, and a variety of phytonutrients. They are a visual feast, not only for their colour and taste, but also for their distinct nutritional profile, which keeps the human body healthy, disease-free, and revitalized. Consuming fruit regularly boosts our energy levels, and-makes us healthy and resilient [1]. Dragon fruit, also known as pitaya, is a unique tropical plant that has numerous nutritional advantages for people owing to its high nutritional content and bioactive substances, which include potent antioxidants. The shape and striking colours of the pitaya's flesh and skins, such as red flesh with pink skin, white flesh with pink skin etc., an exotic fruit [2]. Dragon fruit is also regarded as a therapeutic plant in Asian folk medicine, where traditional healers employ herbal remedies to both prevent and treat illnesses [3]. In addition to being high in water content and fibre, the pulp and peels are also packed with nutrients, including a significant quantity of vitamins, minerals and antioxidants[4].

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Native to tropical India and Southeast Asia, *Emblica officinalis* (aonla) has spread around the world. Being high in polyphenolic flavonoids, ascorbic acid, and other phytochemicals, it has been acknowledged as an exceptional source of antioxidants. These substances primarily protect the human body from oxidative stress, illnesses, and malignancies. Subsequently, by increasing immunity, aonla helps the body in building the ability to combat these conditions. Aonla fruit requires processing for prolonged shelf life, particularly amid the glut season [5], due to its remarkably perishable nature [6].

Fruits that can't be frozen or canned intact can be processed to make fruit spreads. Fruit spreads employ sugar to preserve them. The texture, flavour, and colour of fruit spreads vary, even though they are all slightly jelled. The sort of fruit utilized determines the fruit spread's unique properties [7]. Aonla's high vitamin C content and dragon fruit's antioxidants and fibre combine to enhance the nutritional value when they are blended. This combination attracts customers looking for functional foods and gives health-conscious items more diversity. The goal of the current study was to evaluate the developed dragon-aonla fruit blended spread's physico-chemical, microbiological, and sensory attributes.

MATERIAL AND METHODS

In accordance with the standard process provided by [8], the combination of dragon fruit and Aonla fruit pulp (Figure 1) in varying amounts, T_1 (100:00), T_2 (90:10), T_3 (80:20), T_4 (70:30), T_5 (60:40) and T_6 (50:50), were used to prepare the blended

spread. To attain the appropriate consistency, the blended pulp, sugar and pectin mixture was cooked while constantly being shaken and concentrated to 60ºB. After the product was poured hot into 250 g glass jars that had already been sterilized, it was cooled and stored for three months at ambient temperature (23.6±5.10ºC and RH 60±4%). The samples were analyzed for physico-chemical, microbiological and organoleptic characteristics at one one-month interval.

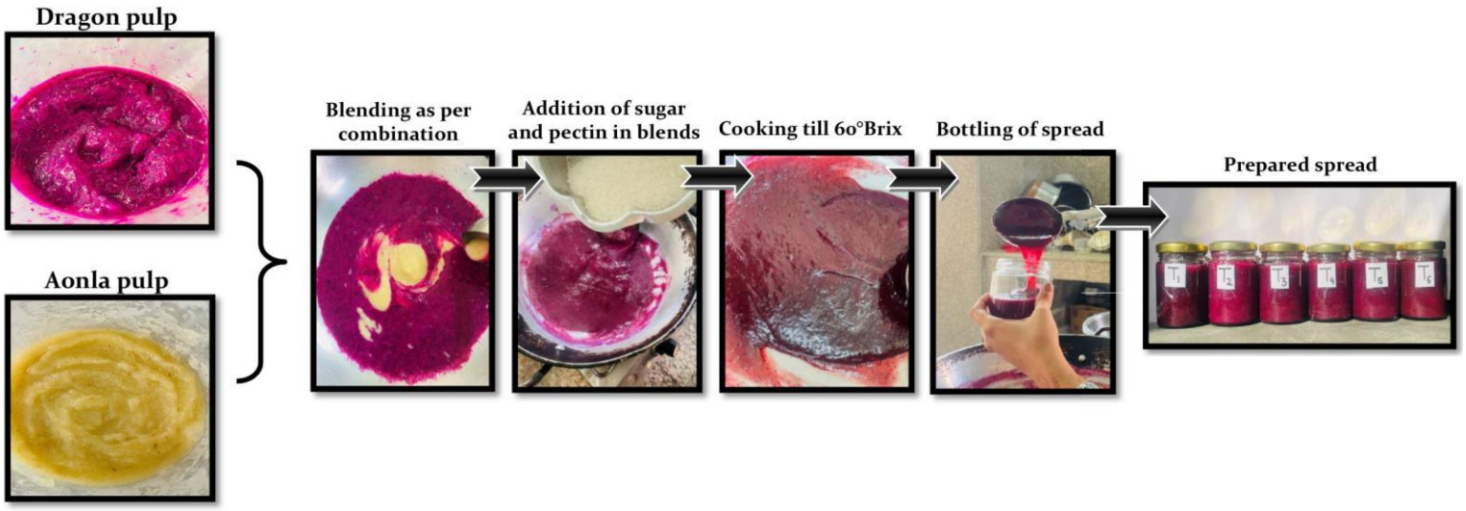

Figure 1: Preparation of dragon-aonla fruit blended spread

Colour of the sample was analyzed using Hunter Lab colour analyzer as per method of [9]. The method outlined by Ranganna [10] was utilized to estimate total soluble solid, ascorbic acid and sugars. Titratable acidity, ash and minerals of samples were estimated by [11] methodology. Crude protein was estimated using standard procedure given by [12]. The betacyanins content was calculated by [13]. The microbial count was done by using standard method of [14]. The sensory analysis was performed as described by [15]. The cost of production of blended spread was also estimated and statistical analysis was conducted using FCRD design [16].

Results and Discussion

L*, a* and b* value

Among the treatments (Figure 2), the incorporation of aonla increases the L* and b* value by 152.28 and 280.19%, respectively, while the a* value declines by 48.83% as aonla concentration increases among treatments. During storage period of three months, L* and b* values of blended spread decreased significantly from 14.27-12.51 and 2.76 to 2.40, respectively whereas a* value increased from 7.64 to 8.52 indicating that the blended spread was losing its particular colour and reducing its lightness. This decrease might be attributed to the occurrence of non-enzymatic browning (Maillards reaction) by forming melanoidins (brown pigment), thus, led to the darkening of the product. Similar variation during storage was recorded by [17] and [18] in value-added products.

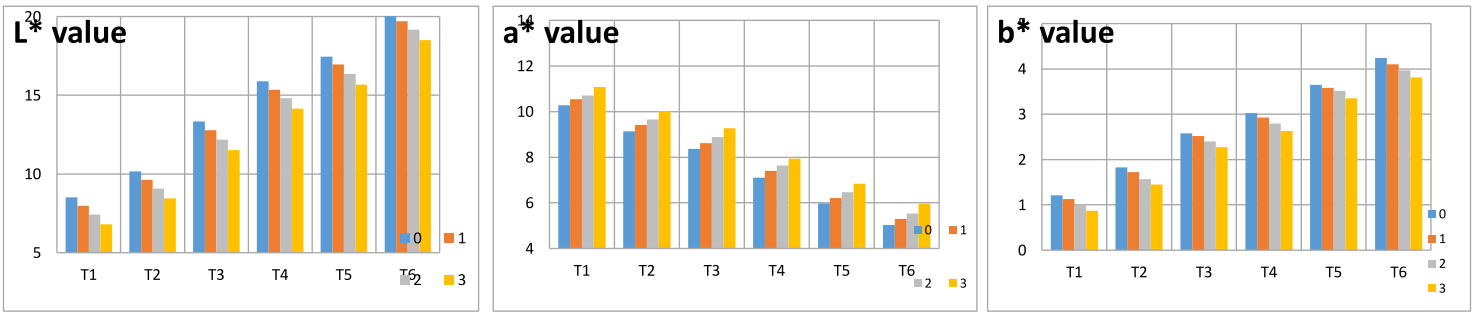

Figure 2: The effect of L, a* and b* values on the dragon-aonla fruit blended spread*

Moisture content, TSS and titratable acidity

The mean moisture content and TSS of blended spread declined by57.69 and 0.76%, respectively whereas titratable acidity increased by 203.98% with the varying levels of dragon fruit and aonla fruit pulp (Figure 3). The overall storage mean moisture decreased by 5.58% which might be due to evaporation of moisture from the samples and utilization of free water in converting polysaccharides into mono and disaccharides, while TSS and titratable acidity increased by 2.32 and 12.82%, respectively, during storage period of three months. In blended spread during storage, the increase of TSS might be due to reduction in moisture content of the product, and conversion of polysaccharides like pectic substances and starch into soluble sugars by acid hydrolysis while the increase in titratable acidity might be due to inter-conversion of sugars that results in the formation of acids and conversion of proteins to amino acids [19]. Similar results were also reported by [20] in papaya jam fortified with soy protein and [8] in apple-beetroot blended spread.

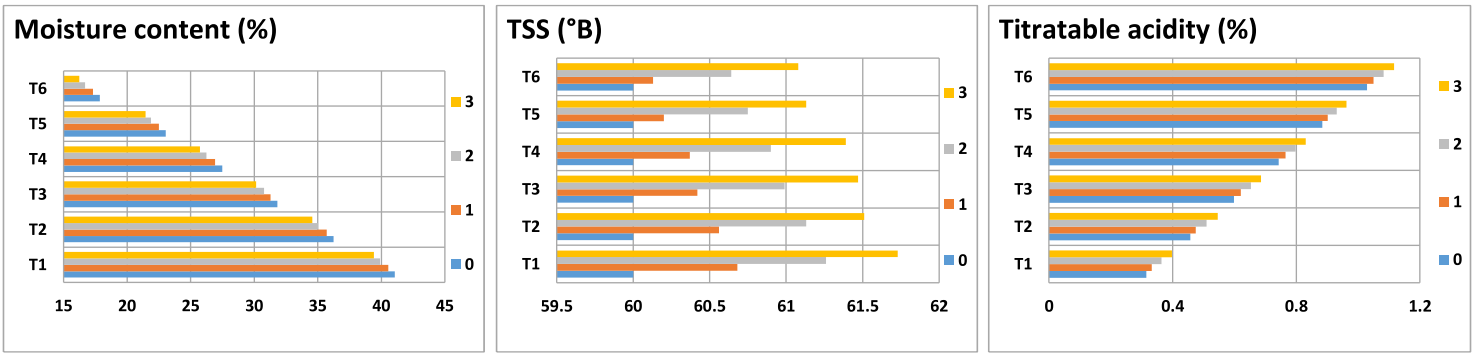

Figure 3: The effect of moisture content, TSS and titratable acidity on the dragon-aonla fruit blended spread

Reducing and Total Sugars

With the incorporation of aonla pulp, the mean value of reducing sugars and total sugars (Figure 4) decreased significantly by 46.57 and 47.51%, respectively. During the storage period of three months, the mean reducing and total sugar content increased significantly from 17.24 to 18.33% and 41.04 to 42.50%, respectively in blended spread. The increase in sugars might be due to inversion of sucrose to glucose and fructose, partial hydrolysis of complex carbohydrates into simple sugars and moisture loss or due to conversion of polysaccharides into monosccharides [19]. [21] in aonla-papaya blended jam and [8] in apple-beetroot blended spread reported a similar declining trend during storage.

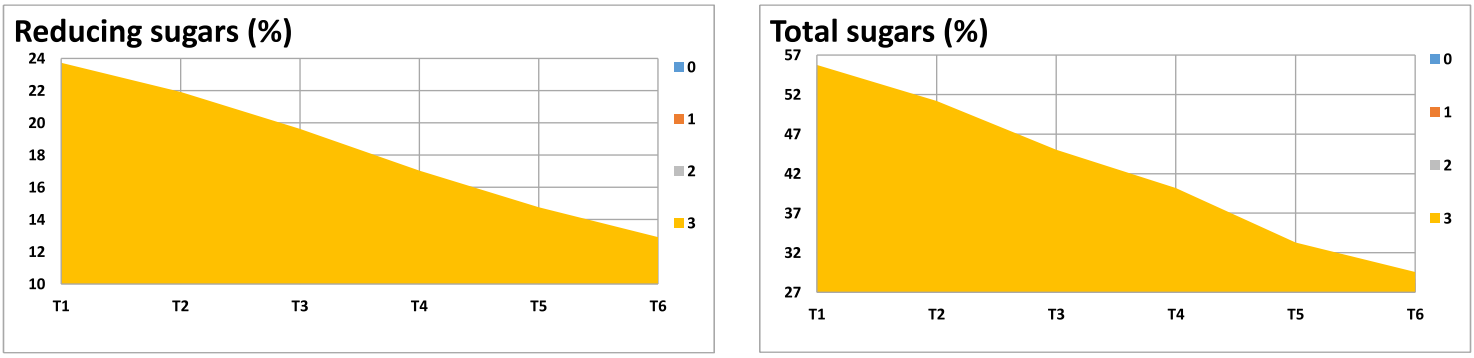

Figure 4: The effect of reducing sugars and total sugars on the dragon-aonla fruit blended spread

Ascorbic acid and betacyanins content

The ascorbic acid in blended spread increased significantly by 859.24% while betacyanin content decreased by 54.69% (Figure 5), among treatments with the decreasing level of dragon fruit pulp. The decrease in the ascorbic acid content (36.52-35.19 mg/100 g) of blended spread during storage might be due to the oxidation of L-ascorbic acid to dehydro-ascorbic acid with the passage of time. The betacyanin content in blended fruit spread also declined by 10.68%, at the end of the third month of storage, which might be due to their high susceptibility to photo-oxidative degradation and poor stability during storage [22]. Similar findings have been reported by [23] in aonla spread variants and [24] in tamarind and plum blended jam.

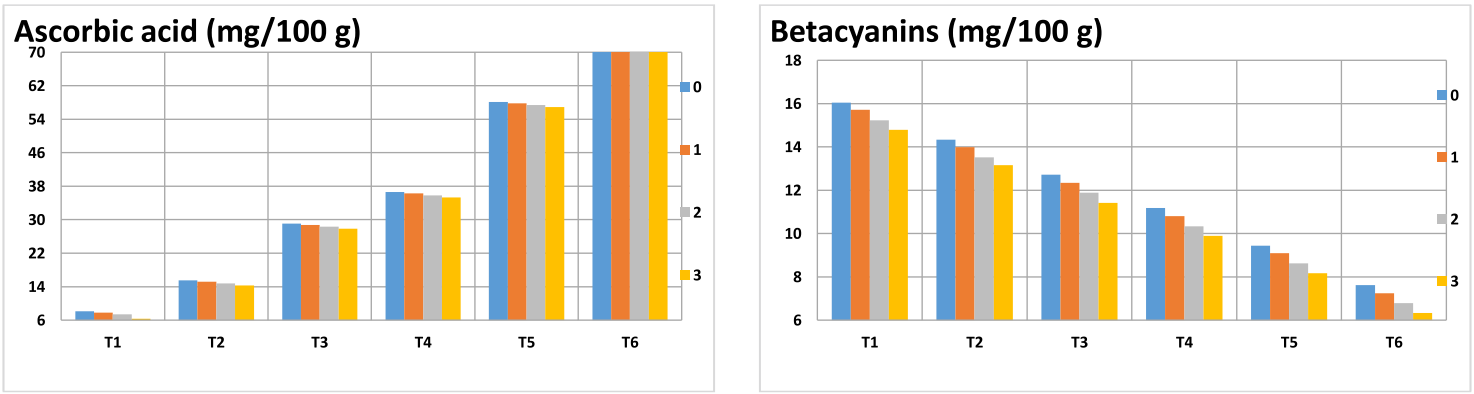

Figure 5: The effect of ascorbic acid and betacyanins content on the dragon-aonla fruit blended spread

Ash, phosphorus and iron content

Among treatments, mean ash, phosphorus and iron content in blended spread varied significantly from 0.538 to 0.627%, 19.53 to 7.91 mg/100 g and 1.281 to 0.589 mg/100 g, respectively (Figure 6). During the storage period of three months, ash, phosphorus and iron content of blended spread decreased significantly from 0.689 to 0.461%, 13.85 to 13.43 mg/100 g and 1.095 to 0.771 mg/100 g, respectively. This decrease in the ash and minerals during storage might be due to the interaction of these minerals with other components like proteins and carbohydrates (Maillards reaction product) making them unavailable [25]. The result is also in agreement with the findings of [26] in jamun-mango blended jam.

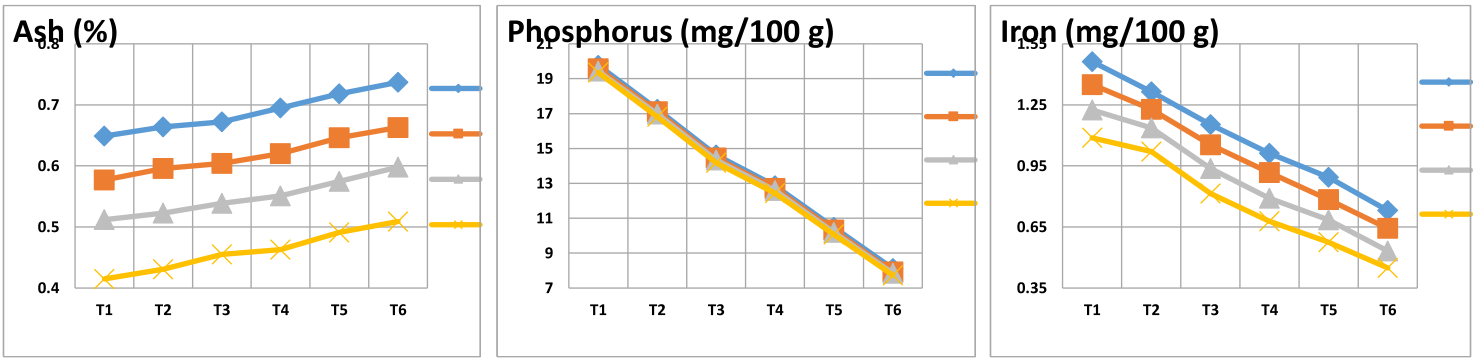

Figure 6: The effect of ash, phosphorus and iron content on the dragon-aonla fruit blended spread

Microbial load

No microbial load was observed till 2 months of storage (Figure 7). Althoug, during 3rd months of storage microbial growth was observed with maximum growth in T_1(0.56x10^{4}cfu/g) and minimum in T_6(0.27x10^{4}cfu/g). The high TSS in blended spread might have created high osmotic pressure and low water activity, thereby limiting the microbial load [27]. However, the blended spread showed acceptable limit (x10^{6}cfu/g) with respect to microbial growth upto their respective storage period [28]. Similar readings were reported by [29] in apple-orange blended jam and [8] in apple-beetroot blended spread.

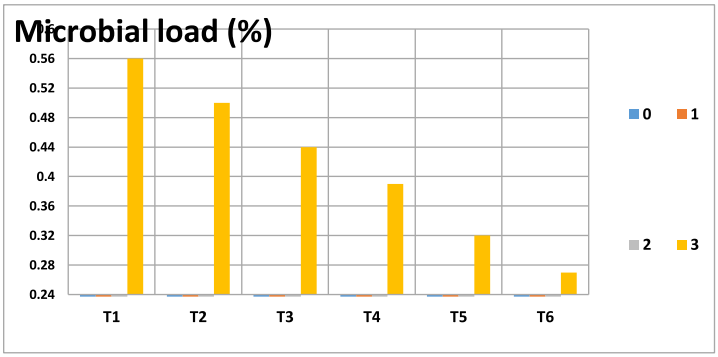

Figure 7: The effect of microbial load on the dragon-aonla fruit blended spread

Sensory properties

The sensory evaluation of dragon-aonla fruit blended spread, indicated a substantial difference between the treatments (Figure 8). Among treatments sensory scores for colour (8.18), texture (8.14), taste (8.02), mouthfeel (8.12) and overall acceptability (8.12)were recorded highest in treatment T_5 (60:40::DF:AF). Colour, texture, taste, mouthfeel and overall acceptability score all declined by 4.43, 5.19, 5.08, 5.10 and 4.86%, respectively, as the storage duration extended. The decrease in the sensory score of the dragon-aonla blended fruit spread might be due to the increase in non-enzymatic browning, absorption of atmospheric moisture, dilution of sugars and changes in acidity, changes in chemical composition of the product over the course of three-months of storage duration. (30) in dragon fruit blended value added product and [8] in fruit blended spread reported similar results.

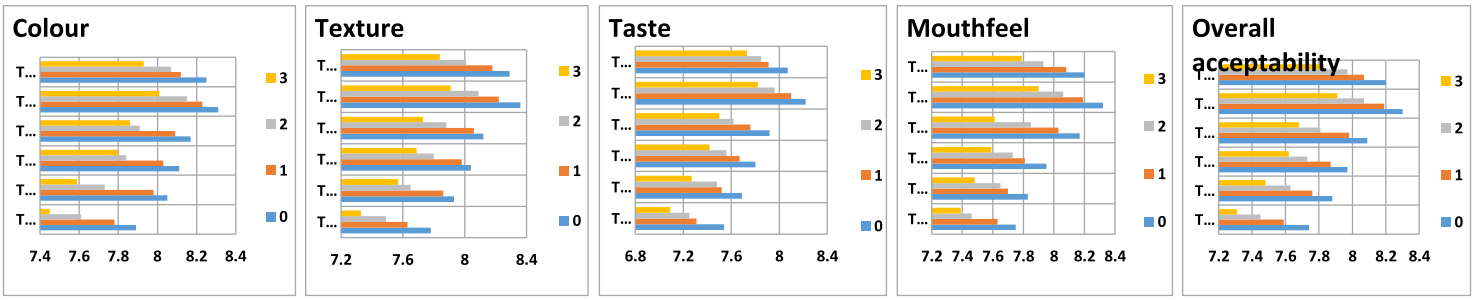

Figure 8: The effect of sensory properties on the dragon-aonla fruit blended spread

Cost of Production

The cost of production of spread containing 40% aonla fruit and 60% dragon fruitpulp (Table 1) was based upon the fixed and variable cost of all the ingredients used. The cost was calculated on the basis of current market price of ingredients used, profit margin (15%) and GST (12%). The cost of production of fruit spread was estimated asRs. 113.61 per 250g.

Table 1: Cost of production of dragon-aonla fruit blended spread

Ingredients	Rate @ ₹	Blended spread T_5 (60:40::DF:AF)	
		Quantity	Amount (₹)
(A) Variable cost			
(a) Cost of inputs			
Dragon fruit	300/Kg	770g	231.0
Aonla fruit	40/Kg	560g	22.4
Sugar	40/Kg	500g	20.0
Pectin	1500/Kg	10g	15.0
Glass jar	3/bottle	4	12.0
Label	0.15/label	4	0.6
Total cost			**301.0**
(b) Cost of labour and fuel per day	@15%		45.15
Total variable cost	a+b		**346.15**
(B) Fixed cost			
Machinery depreciation @ 10% on the total machinery cost of 20,000 for 300 working days in a year	@10%	2000	

Machinery depreciation for oneday		6.67
(C) Profit @15% of total variable cost and fixed cost	@15%	52.92
(D) GST @12% of total variable cost, fixed cost and profit	@12%	48.69
Grand Total for 1 Kg product (₹)		**454.43**
Cost of per spread of 250 g (₹)		**113.61**

CONCLUSION

Dragon fruits and aonla fruit can be combined in the right proportion to develop a fruit spread with more nutritious content. The developed nutritious spread was subjected to a quality assessment. T_5, which is 60% dragon fruit and 40% aonla fruit, was chosen as best out of all the treatments based on a 9-point hedonic scale rating. This wholesome and nourishing spread is a splendid source of betacyanins, sugars, iron, phosphorus, ascorbic acid and titratable acidity. The produced nutritious spread, kept at ambient temperature for up to three months with minimal degradation in nutritional value. Thus, dragon fruit and aonla fruit pulp when blended, develop products with better quality and acceptability.

Future Scope of the study: Dragon fruit is a good source of betacyanin content. While it is popularly consumed fresh, the untapped potential of its value addition is now gaining momentum in India and beyond. Value addition of dragon fruit offers a promising pathway to expand its utility and profitability. With increasing market demand for health-conscious, natural, and functional foods, dragon fruit value addition is not just an option it is an economic opportunity waiting to be explored.

Conflict of interest: The authors declare no conflict of interest.

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