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Sensory evaluation and nutritional analysis of value-added products jam, jelly and candy developed from star fruit and cape gooseberry

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Abstract
The study evaluates the quality of value-added products jam, jelly and candy developed from Star fruit and Cape gooseberry, carried out in the Nutrition Research Laboratory in the Department of Food, Nutrition and Public Health, Naini Agriculture Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh. The sensory evaluation of the products by a panel of 5 judges the judges were requested to evaluates the fruits based preserved products with the help of a score card based on the 9- point Hedonic Scale (Color and Appearance, Consistency, Taste and Flavour and Overall Acceptability)

Keywords: Star fruit, Cape gooseberry, value addition, jam, jelly, candy

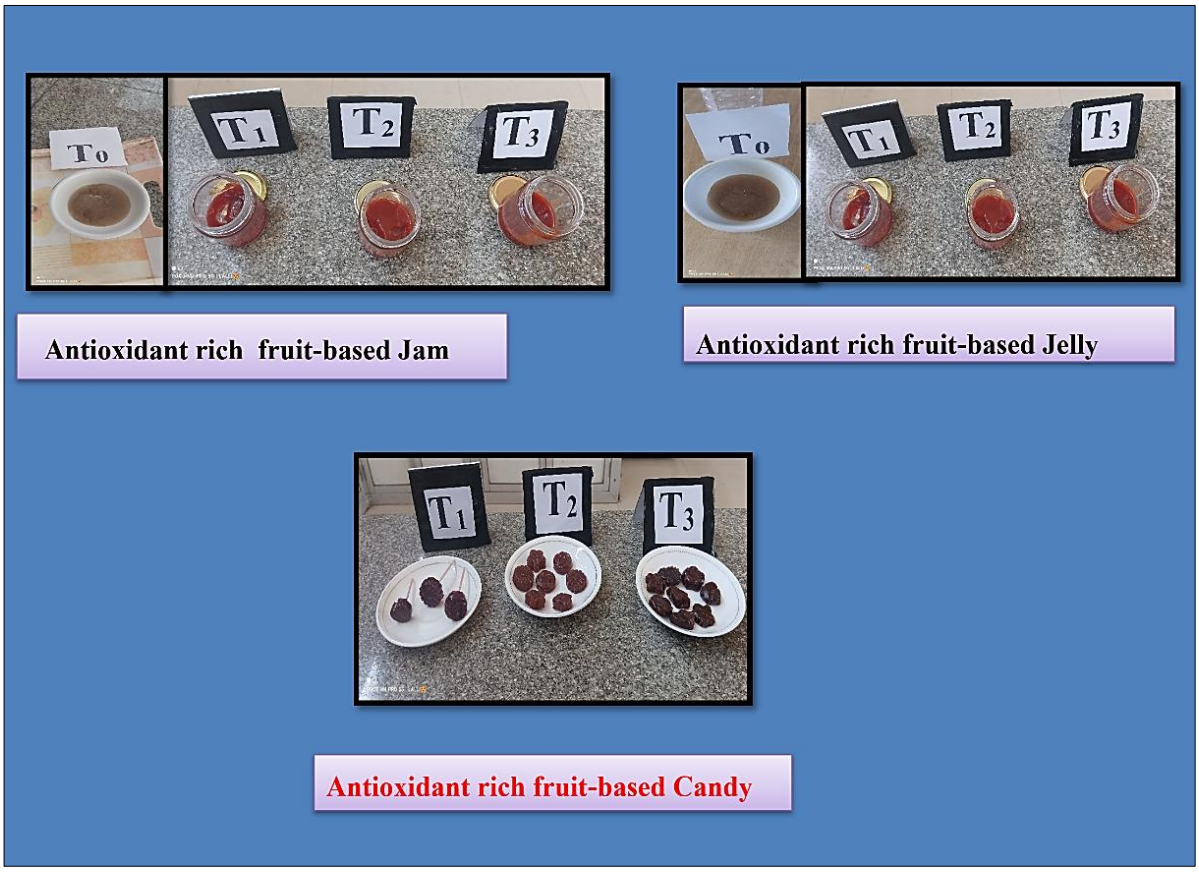
Introduction
Fruits are one of the perishables goods that are necessary for human diets. They are better and more affordable sources of preventive foods, have a high nutritional value and contribute significantly to human welfare.

The fruit has the highest antioxidant properties amongst the various Indian tropical fruits as it is a significant source of phenolic antioxidants hence helps in lowering cholesterol, maintaining blood pressure and body weight. This fruit has anti-inflammatory activity, anti-ulcer activity, hypoglycaemic activity as well as antimicrobial activity. This fruit is added in our diet can meet around 30% of our daily requirement of Vitamin C in just 100 g. (Anita Kanwar and Savita Budhwar, 2018) [1]. The carambola (*Averrhoa carambola* L.), an attractive fruit of the family Oxalidaceae, also known as the "Star fruit" had attained the status of underutilized fruits in Sri Lanka. *Averrhoa carambola*, tropical fruit which has the highest antioxidant properties of fighting against free radicals as well as the damage caused due to free radicals. (Udani *et al.*, 2021) [12] Starfruit is an underutilized fruit and is rich in vitamin C. Fruit leather from starfruit was prepared in this study and analyses of its physicochemical, phytochemical, and sensory characteristics were performed. Five samples named A, B, C, D and E were prepared with different proportions of fruit pulp: sugar of 70:30, 75:25, 80:20, 85:15 and 90:10, respectively. (Gautam *et al.*, 2024) [5] Carambola (*Averrhoa carambola* L.) is a drought resistant, evergreen and multipurpose tree. The word 'carambola' is derived from the Sanskrit word 'Karmaranga' which means "Food appetizer" (Manda et al., 2012) [10] Cape gooseberry rich in vitamin C found in the fruit could also benefit in improving immunity. Vitamin C plays certain important roles in healthy immune system response. Vitamin C is an essential micronutrient for humans, with pleiotropic functions related to its ability to donate electrons. (Carr and Maggini 2017) [2] Cape gooseberry is rich in Vitamins and minerals are found in small amounts in food, yet they are essential substances for metabolism. The impact of vitamins and minerals on health development and disease prevention is significant. (Jyoti *et al.*, 2016) [7] Jaggery, also known as "Gur", is a type of non-centrifugal sugar (NCS) that is widely used in many Asian, African, and South American countries, including India and Colombia. Unlike refined white sugar, which mainly consists of only sucrose, jaggery contains minerals, vitamins, glucose, fructose (invert sugars) in addition to sucrose (Rao *et al.*, 2022) [11].

Jaggery of high quality is golden yellow in colour, hard in texture, crystalline in structure, sweet in taste and low in moisture. A good quality jaggery contains over 70% sucrose, below 10% of glucose and fructose, less than 5% minerals and under 3% moisture. (Hirpara *et al.*, 2020) [6]. Furthermore, the integration of medicinal herbs like mint (*Mentha* spp.), rose petals (Rosa spp.), basil (*Ocimum* spp.) into preserved food products adds functional value. These herbs possess natural antimicrobial, anti-inflammatory, and digestive properties and are known to enhance immunity and metabolic health (Pandey *et al.*, 2014) [8]. Herbal-infused jams, jellies, and candies are increasingly gaining consumer acceptance as they combine traditional. Jam, jelly, and candy products are widely used in breakfasts, baking, and as quick snacks. Their convenience and acceptability make them ideal carriers for delivering nutrients and bio actives. Modern food science is now focused on low-sugar, natural, and herb-infused formulations to meet health-conscious consumer demands (Moura *et al.*, 2022) [9].

Materials and Methods

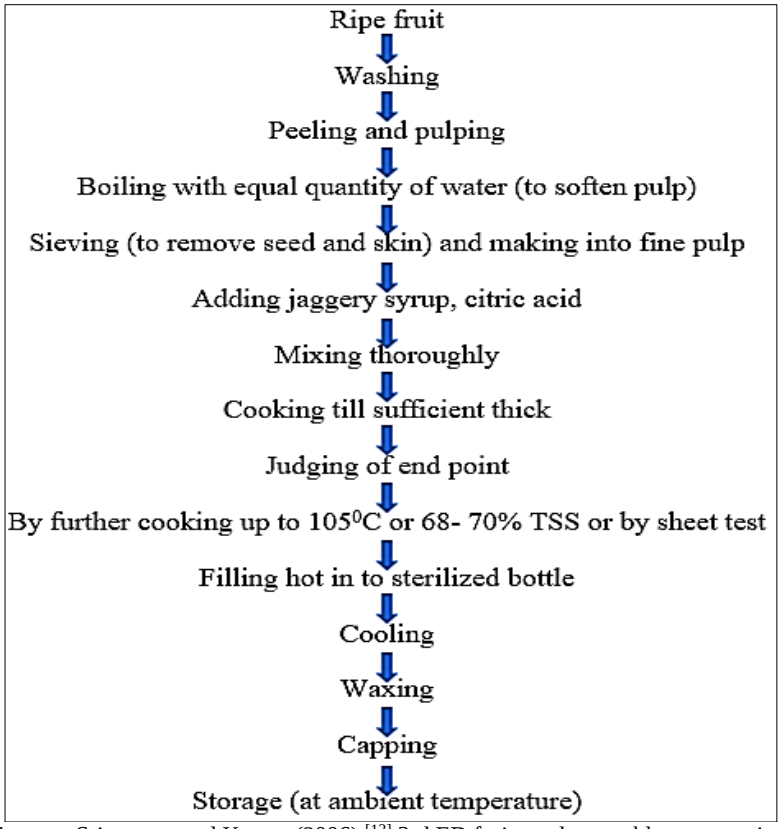
The raw materials Cape gooseberry, star fruit, orange, basil leaves, cinnamon powder, rose petals and other ingredients was procured from local market of Prayagraj. Three products using three different treatments were prepared. First product was jam which had 3 treatments with varying ingredients amount. Second product was jelly with three different amounts of ingredients in it. Third product was candy which also had three different treatments. Every product had 3 treatments, 4 replications and 1 control. The control was made without any alterations or value addition in it. The treatments were made by alterating the ingredients amount and doing the value addition with herbs. The treatments were replicated four times respectively to get an average value.



Prepared preserved fruits-based products

Preparation of jam

Treatment T_2 consisted of 35 g star fruit pulp, 23 g cape gooseberry pulp, 25 g jaggery, 6 g mint leaves, 4 g rose petals, 3 g basil leaves, and 4 g cinnamon. The ingredients were blended properly and cooked under controlled conditions to prepare the jam was found to be best in terms of overall acceptability and nutritional value. T_2 showed the best overall acceptability with 9 points on 9-point hedonic scale. The Nutritional composition of T_2 was 2.45% moisture, 1.80% ash content, 74.47 gm of carbohydrates, 2.75 gm protein, 0.20 gm fats, 311.31 gm energy and 19.22 gm iron. and a sensory score of 8.80 on 9-point hedonic scale which makes it the best treatment.

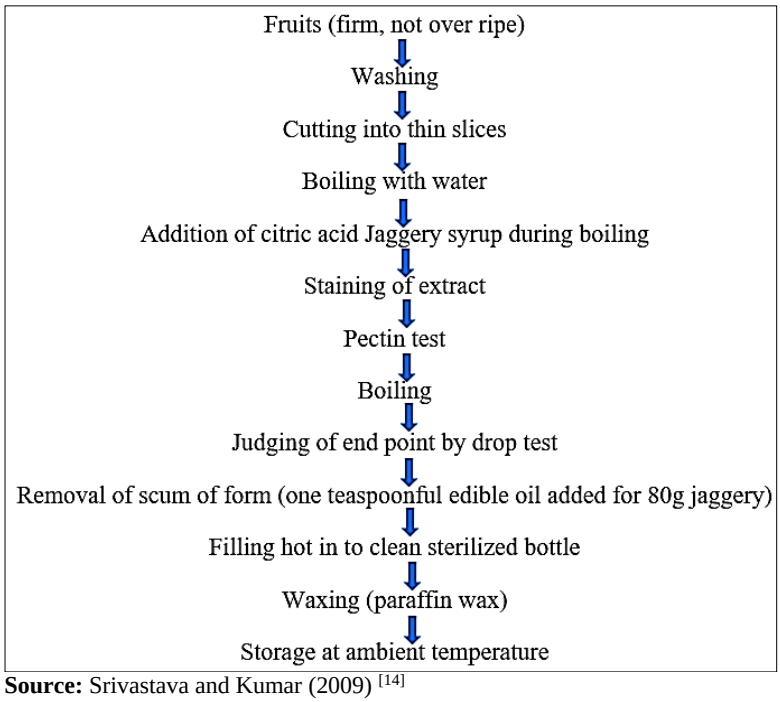


Source: Srivastava and Kumar (2006) [13] 3rd ED fruits and vegetable preservation

Flow diagram of preparation of jam

2.2 Preparation of Jelly

The treatments were made by altering the proportion of ingredients in each treatment. Four replications of the treatment were made to obtain average. Out of three treatments T_2 was the best treatment with the use of the Jelly was prepared by using 26% star fruit pulp, 35% cape gooseberry pulp, and 25% jaggery, along with 5% rose petals, 4% mint leaves, and 5% basil leaves. The mixture was blended uniformly and cooked to achieve the desired jelly consistency. T_2 showed the best overall acceptability with 9 points on 9-point hedonic scale. The Nutritional composition of T_2 was 2.72% moisture, 3.82% ash content,69.81 gm of carbohydrates, 5.30 gm protein, 0.17 gm fats, 301.92 gm energy and 16.58 gm sugar.



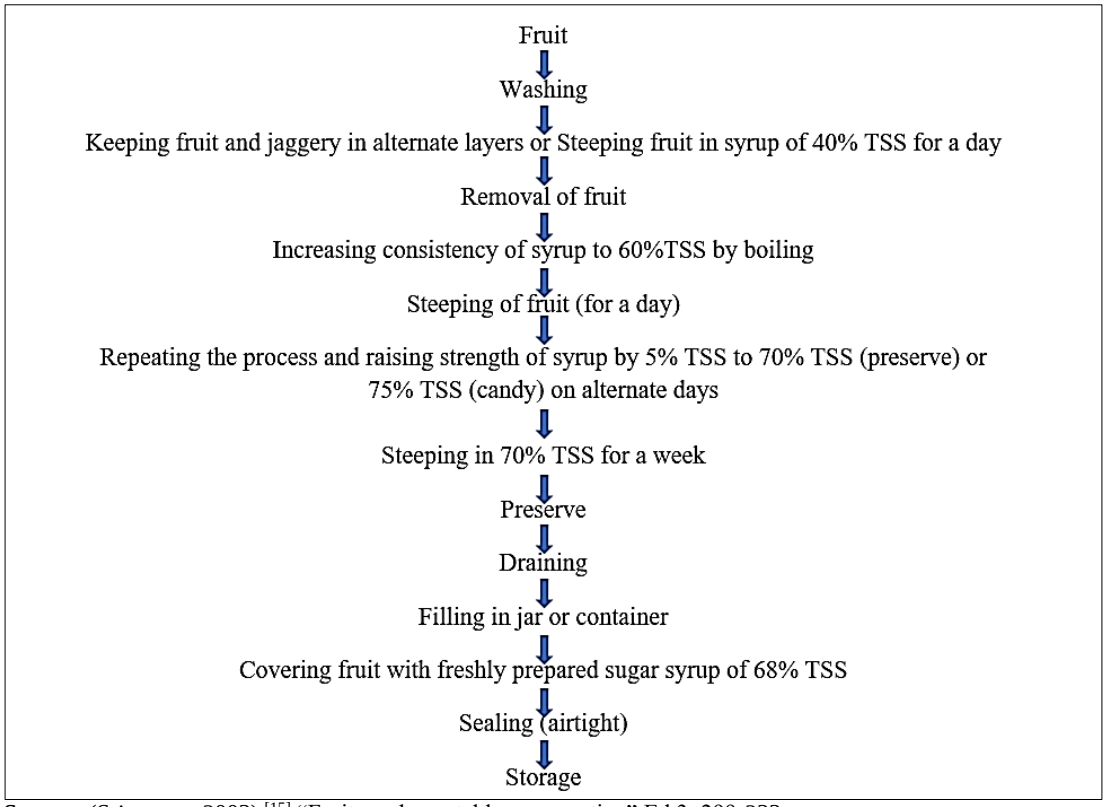
Source: Srivastava and Kumar (2009) [14]

Flow diagram of preparation of jelly

2.3 Preparation of candy

The product had 3 treatments with varying proportion of ingredients in each treatment. Each treatments had 4 replications. Out of 3 treatments T_3 with the use of Cape gooseberry 35%, star 25%, Jaggery 23%, mint leaves 7%, basil leaves 3%, orange 7%, was found to be best in terms of overall acceptability and nutritional value. The T_3 had moisture content of 1.06%, ash 3.22%, carbohydrates 74.15gm, protein 3.35 gm, fat 0.48 gm, energy 298.25 kcal, iron 21.82 mg and a sensory score of 8.80 on 9-point hedonic scale which makes it the best treatment.

Flow diagram of preparation of candy



Source: (Srivastava 2003) [15] "Fruits and vegetable preservation" Ed.3: 299-233.

4. Result and Discussion

The data obtained from different aspects during this research' have been analysed and tabulated statistically to find out the relevant informational facts and also the factual meaning behind them. The results were briefly illustrated with the help of suitable charts. The analysed results are arranged sequentially under the following heads:

The sensory evaluation of fruit-based jam, jelly and candy flavoured with herbs revealed significant variation among treatments for all sensory attributes including colour, aroma, consistency, flavour and taste, and overall acceptability as measured using the 9-point hedonic scale. In the case of jam, treatment T_2 recorded the highest overall acceptability score (8.80) with superior ratings for colour (7.60), aroma (7.80), consistency (8.00) and flavour and taste (8.20), indicating that the optimized level of herbal incorporation improved sensory attributes and consumer preference. Similarly, for jelly, treatment T_2 achieved the highest sensory scores for colour (8.40), aroma (8.60), consistency (8.40) and flavour and taste (8.20), resulting in the maximum overall acceptability score of 9.00, which suggests that the herbal formulation enhanced the gel structure, flavour intensity and overall organoleptic quality of the jelly. In contrast, for fruit-based candy, T_3 exhibited the highest sensory scores, with colour (8.00), aroma (8.00), consistency (8.20), flavour and taste (8.40) and overall acceptability (8.80), indicating that a slightly higher herbal concentration was more suitable for confectionery products compared to spreads. The control treatments in all three products consistently showed lower sensory scores, demonstrating that the addition of herbs improved sensory characteristics such as flavour complexity, aroma intensity and product appearance. Statistical analysis further confirmed that the differences among treatments were significant at the 5% level, indicating that variation in herbal concentration had a significant influence on the organoleptic quality of the developed products. Similar findings have been reported in previous studies, which suggest that herbal extracts and natural flavouring agents can significantly enhance the sensory quality, functional value and consumer acceptance of fruit-based processed foods such as jams, jellies and confectionery products. sensorial characteristics of the 4 gums selected, in terms of visual aspect (colour, homogeneity, and general aspect), aroma (aroma to fruit and to herb), texture (consistency, elasticity, roughness), taste (bitter, sweet, to fruit, to herbs. (Guine R. et al., 2018) [4].

Sensory evaluation chart diagram

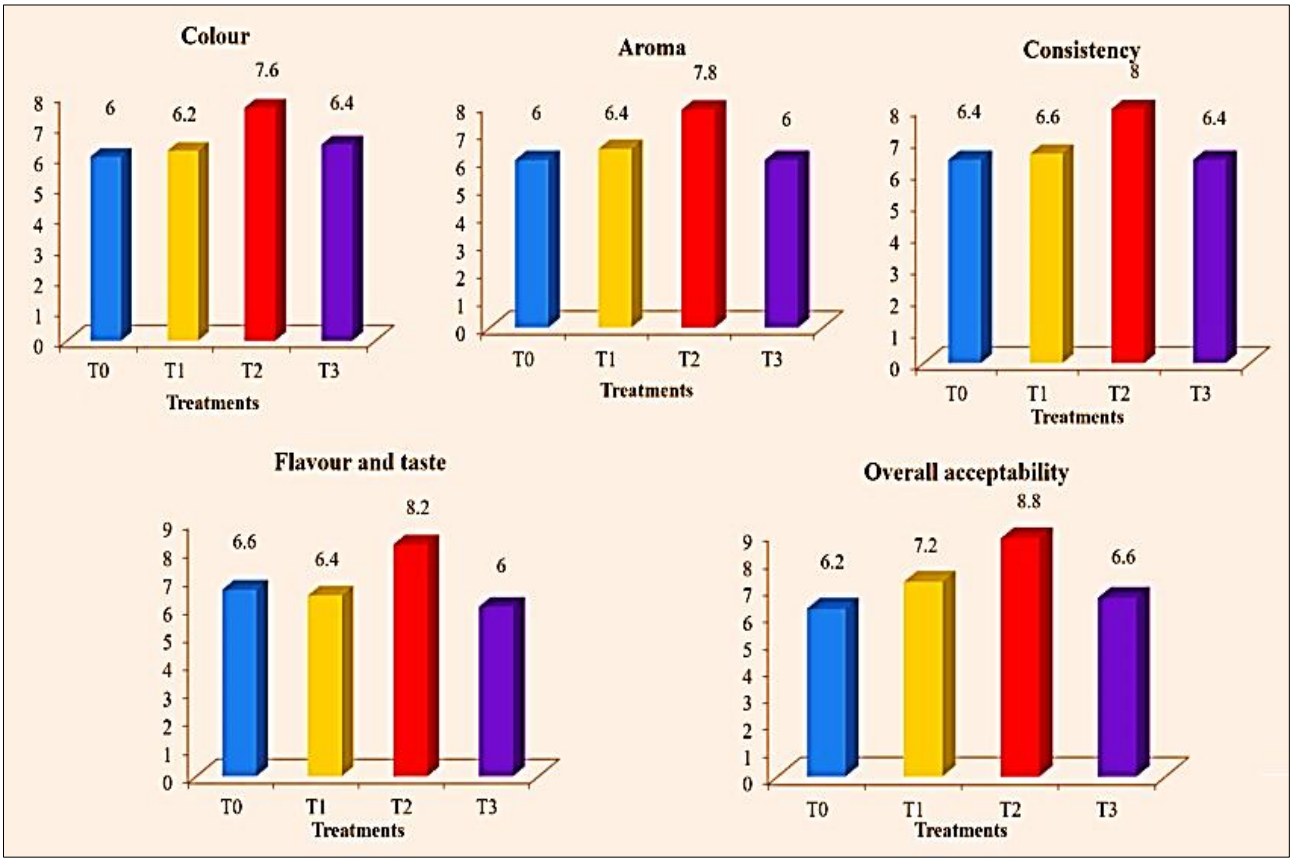


Fig 1: Average Sensory scores of controls and treated samples of Fruit Based Jam flavoured with different herbs.

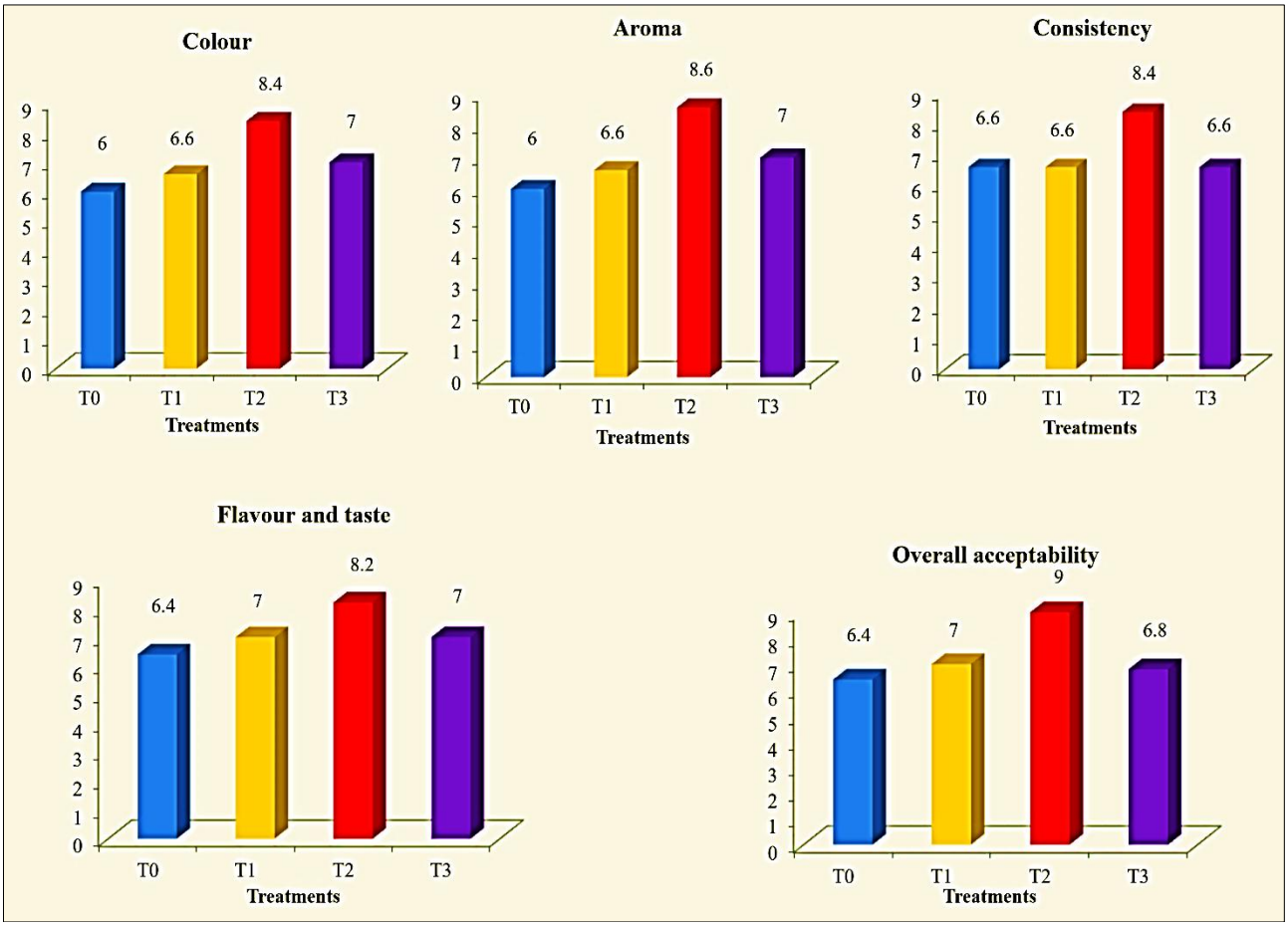


Fig 2: Average Sensory scores of controls and treated samples of Fruit Based Jelly flavoured with different herbs.

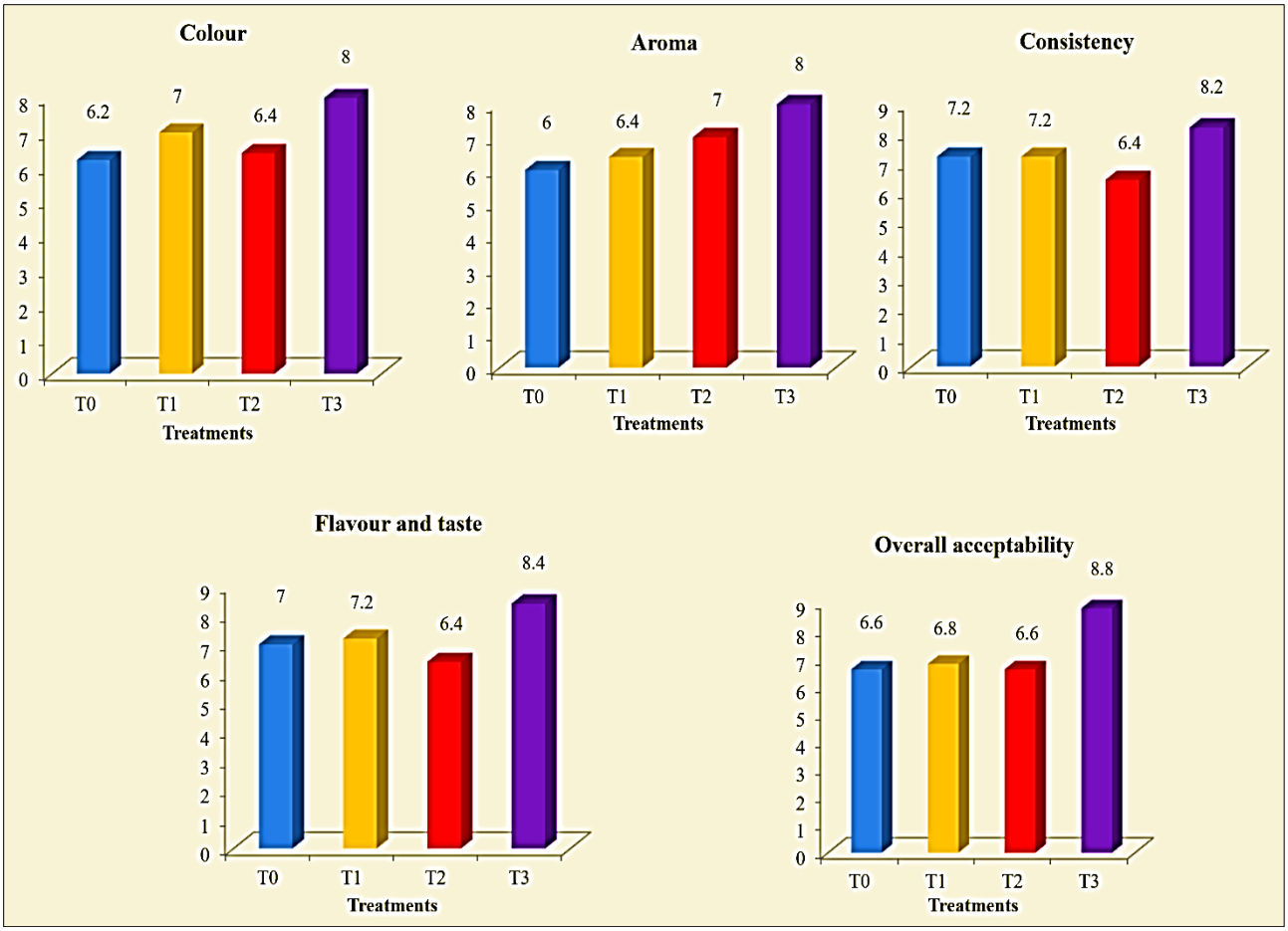


Fig 3: Average Sensory scores of controls and treated samples of Fruit Based Candy flavoured with different herbs.

5. Nutritional analysis

5.1 Nutrient composition (Per 100 gm) in control and treated sample of Fruit Based Jam flavoured with different herbs

Treatments	Treatments				F-test	S. Ed. (±)	C. D. (p = 0.05)
	T_0	T_1	T_2	T_3			
Moisture content	1.80	2.39	2.45	2.33	S	0.045	0.094
Ash content	1.32	1.76	1.80	1.72	S	0.022	0.047
Carbohydrate	54.76	72.82	74.47	71.02	S	0.645	1.356
Protein	2.02	2.69	2.75	2.62	S	0.022	0.046
Fat	0.17	0.19	0.20	0.18	S	0.007	0.014
Energy	228.90	296.87	311.31	304.39	S	0.224	0.47
Fiber	0.25	0.32	0.35	0.34	S	0.021	0.044
Iron	14.13	18.33	19.22	18.79	S	0.23	0.483

5.2 Nutrient composition (Per 100 gm) in control and treated sample of Fruit Based Jelly flavoured with different herbs

Treatments	Treatments				F-test	S. Ed. (±)	C. D. (p = 0.05)
	T_0	T_1	T_2	T_3			
Moisture content	2.00	2.66	2.72	2.59	S	0.050	0.105
Ash content	2.81	3.74	3.82	3.64	S	0.034	0.072
Carbohydrate	51.33	68.26	69.81	66.57	S	0.649	1.363
Protein	3.90	5.18	5.30	5.06	S	0.074	0.156
Fat	0.14	0.17	0.17	0.16	S	0.010	0.021
Energy	221.99	287.91	301.92	295.21	S	0.532	1.118
Fiber	0.07	0.09	0.10	0.10	S	0.006	0.012
Iron	12.19	15.81	16.58	16.21	S	0.109	0.229

5.3 Nutrient composition (Per 100 gm) in control and treated sample of Fruit Based Candy flavoured with different herbs.

Treatments	Treatments				F-test	S. Ed. (±)	C. D. (p = 0.05)
	T_0	T_1	T_2	T_3			
Moisture content	0.78	1.03	1.01	1.06	S	0.011	0.022
Ash content	2.36	3.14	3.07	3.22	S	0.045	0.094
Carbohydrate	54.52	72.5	70.71	74.15	S	0.316	0.664
Protein	2.48	3.27	3.19	3.35	S	0.111	0.233
Fat	0.39	0.46	0.47	0.48	S	0.007	0.016
Energy	219.3	284.41	291.62	298.25	S	0.447	0.939
Fiber	0.17	0.23	0.22	0.25	S	0.007	0.014
Iron	16.04	20.81	21.34	21.82	S	0.244	0.512

Nutritional composition of fruit-based jam and jelly and candy

The nutritional composition of fruit-based jam, jelly and candy prepared with different herbal treatments (T_0-T_3) showed statistically significant differences for all parameters as indicated by the F-test at $p \leq 0.05$, demonstrating that the incorporation of herbal ingredients significantly influenced the nutritional profile of the products. In both jam, jelly and candy the moisture content increased slightly in the treated samples, with the highest value observed in treatment T_2 (2.45% in jam and 2.72% in jelly 1.06 in candy) compared to the control samples (1.80% and 2.00%, 0.78 respectively). This increase may be attributed to the hygroscopic nature of plant constituents present in herbs, which enhance moisture retention in fruit-based products. Overall, treatment T_2 in jam, T_2 in Jelly and T_3 in Candy demonstrated superior nutritional characteristics among had higher nutritional values than the control (T_0). The F-test

indicates significant differences among treatments, showing that herbal flavouring improved the nutritional quality of the jam, jelly and candy. The total energy content of each jam was calculated by multiplying its carbohydrate content, protein content, fat content and fibre content by factors of 4, 4, 9 and 2, respectively and adding these values. The value was expressed in kilocalories per 100 g of the jam. Garg, S. *et al.*, (2019) [3].

Conclusion

This study indicates that the chosen fruits and herbs were high in Nutrient composition like Iron, antioxidants, fiber, vitamins, and minerals and low in calories. These particular fruits and herbs can be successfully included to candies, jams, and jellies. The made jam, jelly, and candies with various herbs and fruits found good sensory scores. It can be concluded that the fruits and herbs like star fruit and cape gooseberry Jam, Jelly and Candy are more acceptable than the control Jam, Jelly and Candy due to its of taste and flavor, consistency, color, and appearance, Any age group can easily consume fruits, herbs, and products enriched with Cape gooseberry, orange, and star into their daily diet, which will increase their intake of protein, fiber, vitamins, minerals, and antioxidants while lowering their calorie intake and protecting the body from degenerative diseases.

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