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Development, Formulation, and Quality Evaluation of Capsicum Annum L. Based Jam

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Abstract
Capsicum annuum L. is a widely cultivated vegetable belonging to the Solanaceae family and is known for its rich content of vitamins, minerals, and natural antioxidants. Red capsicum is especially rich in carotenoids, which provide bright red colour and strong antioxidant properties. Capsicum annuum L. is enriched with antioxidants, where carotenoid gives it a bright red colour, with which it is ideal for making jam. The aim of the current study was to develop jam using Capsicum annuum L. and to evaluate its physicochemical and quality evaluation of the developed product. The product optimization was developed by blanching, in order to inactivate enzymes and to preserve its natural colour. As per the sensory evaluation, the jam prepared with Capsicum annuum L. obtained an overall acceptability with a score of 8.07 ± 0.26 on a 9-point hedonic scale which showed good acceptability, in which colour and appearance received higher scores. The TSS content of the final product was measured as 74%, and the pH was 4.5 and TA was found to be 0.35 for the final product. Microbiological quality was assessed by total plate count with no observable growth suggested product stability. Therefore, it can be concluded that Capsicum annuum L. can be effectively used for the development of a jam without any synthetic additives or preservatives successfully.
Keywords: *capsicum annuum, quality, sensory, physicochemical, formulation, preparation*

1. Introduction
Red bell pepper (Capsicum annuum L.) is a member of the Solanaceae family, which also encompasses potatoes, tomatoes, and eggplants. It is originally from Central and South America, as well as the Caribbean, and has been cultivated for over 5,000 years [1]. Various types of Capsicum annuum, such as sweet, semi-hot, and hot peppers, are grown globally and can be enjoyed in both fresh and processed forms. Peppers are abundant in vitamins, phenolic compounds, flavonoids, and carotenoids, which possess antioxidant, anti-inflammatory, and immunomodulatory effects [2]. The vibrant color and level of pungency are recognized as crucial quality characteristics, which differ among varieties due to variations in capsaicin and carotenoid concentration [3]. Chime peppers are exceedingly perishable in nature, driving to significant post harvest misfortunes, particularly amid top generation seasons [4]. In this manner, handling into value-added items such as glue, dried items, ready-to-eat (RTE), and ready-to-cook (RTC) nourishments can offer assistance in diminishing misfortunes and progressing financial esteem [5]. Warm medications such as whitening are commonly utilized some time recently solidifying or drying to diminish microbial defilement and protein movement, subsequently making a difference to hold colour, surface, and enhance (Hamza et al., 2018). Ponders have moreover detailed that chime pepper is one of the major vegetables prepared after tomato in a few nations due to its tall generation and request [6]. Pectin, a natural polysaccharide present in fruits, plays a crucial role in gel formation during jam preparation. Suitable proportions of sugar and acid are required along with pectin to obtain the desired texture, flavor, and preservation properties in jam [7]. Chime pepper mash can be utilized for the planning of novel items such as stick, sauces, and spreads, which may upgrade its utilization and rack life whereas keeping up dietary quality [4]. Subsequently, the display consider was attempted for the advancement, formulation, and quality assessment of

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Capsicum annuum L. based jam, beside tangible assessment and investigation of chosen physicochemical properties.

2. Materials and Methods

Fresh fruits of the commonly consumed Capsicum annuum L. variety Inspiration RZ F1 were procured from a local supermarket. The other ingredients required for the study, such as sugar and citric acid (lemon), were obtained from a standard retail market

2.1.Preparation of Jam

Fresh Capsicum annuum L. fruits were separated from the stems after being sorted to remove any broken parts. The chosen fruits were weighed after being carefully cleaned with pure water to get rid of any dirt or contaminants. After cleaning, the fruits were blanched to render the enzymes inactive mixed thereafter to produce a consistent pulp. After the pulp was cooked in a pan over a direct flame to concentrate the mixture, a refractometer was used to measure the total soluble solids (°Brix). During the heating process, the necessary amounts of sugar and citric acid were added to achieve the right sweetness, gel formation, and preservation. The jam was put hot into sterile, clean containers and allowed to cool at room temperature after being cooked until the correct consistency was achieved. The flow chart for jam preparation is shown in Figure 1. [8]

Fresh capsicum annuum L
↓
Sorting
↓
Washing
↓
Cutting
↓
Blanching
↓
Grinding
↓
Addition of ingredients (sugar and citric acid)
↓
Evaporation
↓
Filling

Figure 1 Flow chart of jam preparation

Table 1 Formulation of jam production

Ingredients	Quantity
Red bell pepper (capsicum annuum L)	250gm
sugar	200gm
Lemon juice	3ml

Fresh Capsicum annuum fruits were properly cleaned before being sliced into roughly 2 cm thick pieces and blanched at 100°C for 10 minutes to inactivate enzymes in order to make bell pepper jam. To create a homogenous pulp, the blanched pieces were mixed. The pulp was moved to a pan and cooked over a direct flame. To achieve the right sweetness and consistency, the necessary amount of sugar was progressively added to the pulp while it was cooking and stirred constantly. [9] Later in the heating process, citric acid or lemon juice was added to balance the acidity and promote gel formation. The mixture was cooked until the total soluble solids reached 74°Bx, which was measured using a refractometer. The pH of the final product was recorded as 4.5, and titratable acidity was determined by titration with 0.1 N NaOH until the end point turned light pink, colour. All experiments were carried out in triplicate. All analysis were carried out in triplicates (Okudu et al., 2010; Onwuka, 2018). The prepared jam was hot-filled into sterilized glass jars, immediately sealed, and stored at room temperature for further analysis. [10-11]

2.2.Sensory evaluation of developed jam

Sensory evaluation was carried out by 15 semi-trained panelists. The prepared jam samples were presented at room temperature under normal lighting conditions. The samples were evaluated for colour, aroma, taste, sweetness, spreadability, appearance, and overall acceptability using a nine-point hedonic scale. [13] The scale consisted of the following ratings: 9 – Like extremely, 8 – Like very much, 7 – Like moderately, 6 – Like slightly, 5 – Neither like nor dislike, 4 – Dislike slightly, 3 – Dislike moderately, 2 – Dislike very much, and 1 – Dislike extremely. [14-15]

3. Statistical analysis

The obtained data were compiled and analyzed for mean and standard deviation using MS Excel for

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proper presentation of the results.

4. Results and Discussion

4.1. Result

Table 2 physicochemical characteristics

Parameters	Values
Total Soluble Solids (TSS)	74 °Brix
Titratable Acidity (TA)	0.35 %
Total Plate Count (TPC)	Not detected (CFU/g)
Sensory Score	8.07 (9-point hedonic scale)

The prepared bell pepper jam (Capsicum annuum L.) showed 74% total soluble solids (TSS) and 0.35% titratable acidity (TA). According to Desrosier and Desrosier, the standard TSS value for jam should be slightly above 65%, which is necessary for proper gel formation and preservation (Jayed et al., 2023) [15]. The results obtained in the present study were within the acceptable range for jam preparation. Similar findings have been reported in previous studies on pepper and fruit-based products. The pH value of cayenne pepper was reported as 5.84, and the titratable acidity ranged from 0.08 to 0.09%. In another study, the titratable acidity of mixed fruit jams ranged from 0.33 to 0.48% (Chidiamara et al., 2024) [18]. In comparison with these studies, the bell pepper jam developed in the present investigation showed a titratable acidity of 0.35%, which falls within the acceptable range for jam products, indicating good quality and stability. According to the documented literature, jam prepared using different concentrations of sugar exhibited a pH value of 3.8, whereas in the present study the pH was observed in the range of 3.09 ± 0.06 –4.67± 0.40 (Adetero et al.,2022)[17] In a study conducted with beetroot, the pH was 3.8(Perumpuli et al.,2018)[16] Microbiological analysis for total plate count for yeasts and mould showed no visible growth, indicating a safer consumption.

4.2.Sensory analysis

Sensory analysis was done by 15 semi- trained panelists. In sensory evaluation panelists analyzed colour, aroma, taste, sweetness, spreadability, appearance and overall acceptance. The analysis of the data revealed that the preference to vary between moderate liking to very much. In a study conducted with Cayenne Hausa (Sugar), the sensory evaluation revealed a range of 7.88±0.82 with an overall acceptability [14]. In the parameters, colour and appearance scored higher with a range of 8.60±0.51 and 8.47±0.52, whereas, aroma showed higher SD slight variation with a range of 7.07±0.88. Overall acceptability is 8.07±0.26 indicating a good consumer acceptance.

Table 3 Mean sensory score of the prepared jam

Sensory Attributes	Mean ± SD
Color	8.60 ± 0.51
Appearance	8.47 ± 0.52
Aroma	7.07 ± 0.88
Taste	7.67 ± 0.72
Sweetness	7.27 ± 0.70
Spreadability	7.93 ± 0.70
Overall Acceptability	8.07 ± 0.26

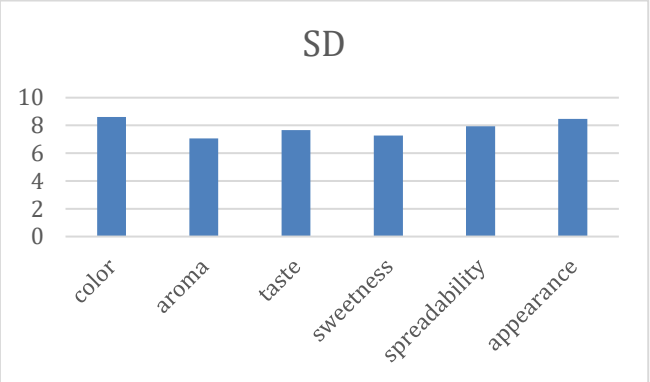

Figure 2 Sensory profile of capsicum annuum L based jam

Conclusion

The developed jam showed no detectable microbial growth in the total plate count (TPC), indicating good microbiological stability. Sensory evaluation showed good overall acceptability of the product. The pH of the jam was around 4.5, which falls within the acceptable range for jam products. The total soluble solids (TSS) were 74 °Brix, confirming proper gel formation and preservation. Overall, the developed jam exhibited satisfactory physicochemical, microbiological, and sensory quality.

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