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Physico-chemical evaluation of tomato powder

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Abstract
The present study explored converting surplus tomatoes into powder using hot air oven drying method for two tomato varieties *Angoorlata* and *Azad*T6. The two varieties differed in appearance and composition. Fruits of *Angoorlata* variety are small, oval, yellowish-red, with a locule count of 2.33, average weight of 46.33 grams, and pericarp thickness of 0.018 cm. They have an edible index of 93.36%, and a waste index of 5.33%. AzadT6 tomatoes are medium, spherical, deep red, with a locule count of 3.33, average weight of 65.33 grams, and pericarp thickness of 0.023 cm. They have a flesh percentage of 78.33, skin percentage of 5.3, seed percentage of 5.06, an edible index of 98.16%, and a waste index of 2.16%. Beta-carotene content in Angoorlata variety was estimated to be 10.50 mg/100g whereas 12.19 mg/100g in AzadT6 Results of sensory evaluation showed highest overall acceptability for tomato powder of *Angoorlata* variety. Present study underscores the benefits of transforming surplus tomatoes into powder to extend shelf life and minimize waste while preserving nutritional and sensory qualities.

Keywords: Tomato, sensory evaluation, proximate composition, lycopene

Introduction
Tomatoes (*Solanum lycopersicum*), members of the nightshade family (*Solanaceae*), are botanically classified as fruits but are commonly treated as vegetables in culinary contexts. They are cultivated worldwide and hold significant agricultural importance. In India, tomatoes rank third in prominence after potatoes and onions, whereas globally, they are second only to potatoes (Al-Amri, 2013) [1]. Although commonly consumed fresh, processed tomato products-such as pulp, puree, paste, sauce, juice, powder, and peeled tomatoes-make up over 80% of consumption. Tomato powder, in particular, is widely utilized in various products, including soups, instant sauce mixes, ketchup, traditional dishes like *sambhar* and *rasam*, baked goods, health foods, baby food, chocolates, and snacks (Temitope *et al.*, 2009) [12]. Drying is a traditional and easiest method of food preservation. It reduces moisture content, thus preventing spoilage by microorganisms, enzymes, and chemical reactions. This process extends shelf life and enables long-distance distribution (Nishizono *et al.*, 2023) [8]. Tomatoes are rich in carotenoids, including lycopene and β-carotene, which provide numerous health benefits (Srivastava & Kulshreshtha, 2013) [11]. Their chemical makeup is influenced by factors such as variety, ripeness, and growing conditions (García-Valverde *et al.*, 2013) [4]. Regular consumption of fresh or processed tomatoes has been linked to reduced risks of inflammation, cancer, cardiovascular diseases, and obesity, as well as enhanced protection against oxidative DNA damage (Raiola *et al.*, 2014) [9]. Tomatoes also offer various health benefits, such as lowering cholesterol, improving vision, supporting digestive health, reducing hypertension, managing diabetes, protecting skin, and preventing urinary tract infections and gallstones. Lycopene is commonly used in cosmetics, pharmaceuticals, and as a natural food colorant (Kumar *et al.*, 2012) [6]. This versatile fruit not only plays a vital role in culinary traditions but also contributes significantly to health and industrial applications.

Materials and Methods
Present investigation was carried out in the Laboratory of Department of Food Science, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, 208002 (UP). Required analysis in this study was conducted at the Regional Food Research & Analysis Centre (RFRAC), Department of Horticulture & Food Processing (UP), Udyan Bhavan Campus,2 Sapru Marg Lucknow 226001.

Duration of the study
The present study was conducted from October 2020 to August 2021.

Procurement of raw material
For carrying out experiments, fully ripened tomato of AzadT6 and Angoorlata varieties were procured from the Department of Vegetable Science of C.S.A. University of Agriculture & Technology, Kanpur in the month of February.

Physical properties of tomatoes
The physical characteristics of tomatoes, including colour, size, and shape, were recorded through visual observation. Locule numbers are counted by cutting ten randomly selected fruits transversely, while pericarp thickness is measured using vernier callipers in triplicate. The weight of ten randomly selected fruits is determined using an electronic weighing balance, and the average weight is calculated. The weight of pulp is measured from 1 kg of tomatoes using both manual and electronic methods. Similarly, the weight of wastage, which includes peel and seeds, is recorded, and the Waste Index is calculated by expressing the waste materials as a percentage. By using formula: Weight of waste portion = weight of peel + weight of seeds. The percentage of edible mass is determined using the formula: Edible mass (%) = 100 – Waste index (%).

Preparation of tomato powder
Tomatoes were weighed, washed thoroughly under running tap water to remove dirt and soil, and drain out excess water, sorted, then sliced to 5-7 mm thickness slices using knife prior to pretreatment process. The slices were kept in a stainless-steel sieve placed over a pan containing boiling water and blanched for 20 seconds. Blanching loosened the skin of tomato and easily removed. Tomato slices were dried from each variety (*Angoorlata* and *Azad* T6) of tomato. Slices were placed uniformly in a thin layer onto the stainless-steel trays of size 15×20mm and dried in hot air oven at temperature 65 ºC. Observations were recorded in triplicates. The dried tomato slices were then powdered in a grinder jar.

Proximate Analysis of Tomato Powder
Proximate analysis of tomato powder was done at RFRAC laboratory, Lucknow, U.P. (AOAC 2000). Samples were analysed in triplicates and results are expressed on dry weight basis.

Statistical Analysis
Mean, standard deviation (SD) and standard error± (SD) were used to analyse the data. Considering the confidence level of 95% the difference between the mean values considered to be significant at $p< 0.05$.

Results and Discussion
Physical characteristics of tomato varieties
Visual observations highlighted differences in the colour, size, and shape of the two tomato varieties. *Angoorlata* was oval in shape with a yellowish-red hue, while AzadT6 had a spherical shape and a deep red colour, findings similar to those reported by Gupta *et al*. (2011) [5]. *Angoorlata* was smaller in size compared to AzadT6, with fruit diameters measured at 4×5 cm for *Angoorlata* (classified as small) and 5×5 cm for AzadT6 (classified as medium). The locule numbers ranged from 2 to 3 in *Angoorlata* and 3 to 4 in AzadT6, showing a positive correlation between fruit size and locule number, as also noted by Thakur and Kaushal (1995) [13]. The fruit weights of the varieties ranged from 48 grams (maximum for *Angoorlata*) to 65 grams (maximum for AzadT6), with a positive correlation observed between the two varieties. The pericarp thickness was measured at 0.018 cm for *Angoorlata* and 0.023 cm for AzadT6. AzadT6 exhibited higher flesh content compared to *Angoorlata*, which correlated positively with pericarp thickness and fruit weight. However, *Angoorlata* had relatively higher seed content than AzadT6 (Table 1).

Table 1: Physical Properties of the tomato varieties

Variety	Shape	Average Weight	Edible mass	Colour of the powder	Yield of Tomato powder (%)
Angoorlata	Oval	46.33	93.36	Red	44
Azad T6	Spherical	65.33	98.16	Red	48

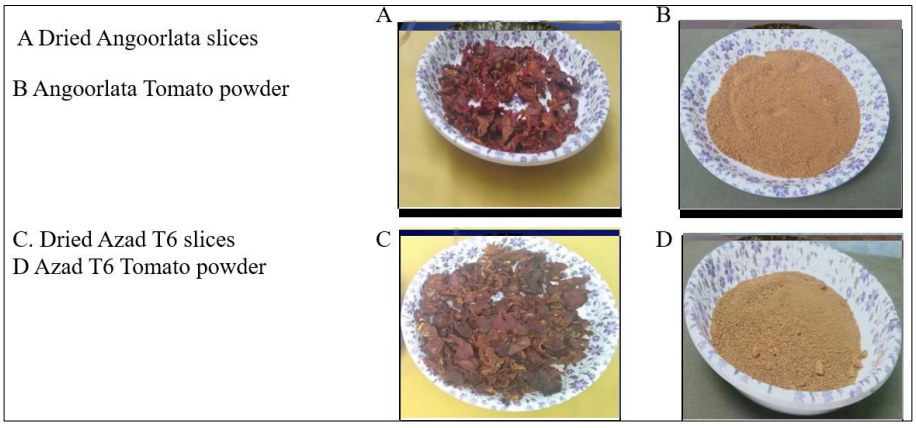

Plate 1: Images of dried tomato slices and their powder

Proximate Composition of Tomato Powder
Moisture content in *Angoorlata* and *Azad*T6 tomato varieties varied from 5.8 to 5.43. The ash content (12.53%) of *Angoorlata* was found to be higher than *Azad*T6 Similar result was observed by (Bindu *et al.*, 2016) [3] they found that tomato dried in hot air oven had low moisture and ash

content than any other drying method. They also reported that, difference in moisture and ash content by different drying methods was significantly affected by tomato varieties. The protein content was 7.07 and 7.36 in *Angoorlata* and *Azad*T6 respectively. Total solid content and crude fibre was found to be higher in powder of AzadT6 tomato compared to *Angoorlata*. There was significant difference between total solids content and crude fibre in between the varieties of tomato. Mozumdzr *et al*.,2012 reported that the crude fiber content was higher in hybrid tomato varieties than commercial tomatoes (Table-2)

Table 2: Proximate composition of tomato powder

Tomato Variety	Drying method	Proximate composition					
		Moisture (%)	Ash (%)	Protein (%)	Fat (%)	Total Solids (%)	Crude Fibre (%)
Angoorlata	Hot air oven drying	5.8	12.53	7.07	2.25	82.26	12.53
AzadT6		5.43	7.02	7.36	1.76	83.79	15.06
SD		0.26	3.89	0.2	0.34	1.08	1.78
SE±		0.15	2.24	0.11	0.2	0.62	1.03
CD (5%)		0.62	0.67	0.35	0.56	0.67	0.66

Lycopene and beta-carotene content in Tomato powder

The importance of tomatoes in human diet is due to presence of lycopene. Lycopene may be considered as a valuable quality attribute of tomatoes. 80-90% of the total carotenoids are present in the tomatoes are in the form of lycopene which add value to finished products. Lycopene and beta carotene content of the tomato powder is presented in table 3 and Fig-1.

Table 3: Lycopene and beta-carotene content in hot air oven dried tomato powder

Tomato vareities	Drying method	Lycopene (mg/100gm)	β-carotene (mg/100gm)
Angoorlata	Hot air oven drying	1.74	10.50
AzadT6		1.83	12.19
SD		0.06	1.19
SE±		0.03	0.68
CD (5%)		0.04	0.41

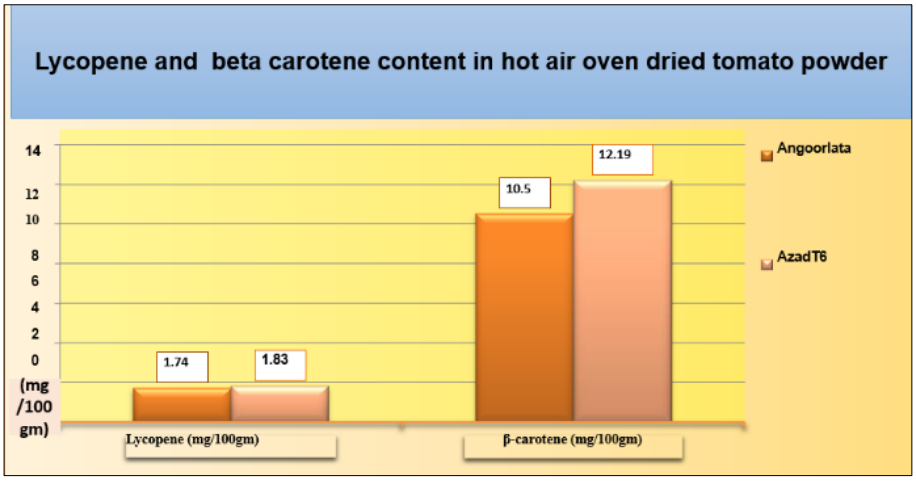

Fig 1: Lycopene and Beta carotene content of Tomato powder

It could be seen from the table 3 and figure 1 that lycopene and beta- carotene content in both the varieties of tomato powder were significantly different from each other.

Conclusion

Drying tomatoes is an effective method to extend their shelf life, reducing waste and enabling their use in a variety of products such as soups, sauces, and nutritional supplements. Additionally, it improves the bioavailability of lycopene, a powerful antioxidant associated with a lower risk of several diseases, including certain cancers and cardiovascular issues. Tomato powder, in particular, is highly versatile and has widespread applications within the food industry. Converting fresh tomatoes into powder simplifies storage and transportation, minimizing spoilage and waste. This also helps stabilize the tomato market by ensuring a consistent supply of tomato-based products throughout the year, irrespective of seasonal harvests. The research highlights the significance of choosing the appropriate tomato variety to achieve superior tomato powder. By optimizing these factors, it is possible to produce a product that maintains the highest nutritional and physical qualities of fresh tomatoes. Overall, the development of tomato powder represents a major advancement in food processing, offering a sustainable way to reduce waste and ensure the year-round availability of nutritious, tomato-based products.

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