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Development of instant tomato powder using different drying technology

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Abstract
Tomato is a Solanaceous fruit vegetable, believed to have its origin in tropical America. The word tomato comes from the Spanish tomato, which in turn comes from the Nahuati word tomata meaning "the swelling fruit". It adds variety of colour and flavor to the food and also rich in medicinal values. The objective of our research is to development of Instant Tomato Powder and analysis of quality parameters. The final results shows that tomatoes were dried under tray and hot air oven drier at temperature of 60˚C with blanching of 90 °C for 30sec. Compared to hot air oven dryer, the quality parameters of tray dryer were high. Thus, different value-added products from tomato were done by using tray dryer was tomato powder. Quality parameters like moisture content, ash content, bulk density, tapered density, flowability, Carr index, swelling capacity and sensory evaluation of different tomato powders was analysed.

Keywords: tray dryer, tomato, hot air oven

Introduction
Fruits and vegetables are important ingredients of the human food as they provide, apart from calories, the much-needed vitamins and micronutrients in the diet. India's varied agro-climatic conditions provide an enormous scope for cultivation of almost all varieties of tropical, sub-tropical and temperate fruits and vegetables. India has emerged as the second largest producer of fruits and vegetable in the world after Brazil and China (GOI, 2020) [4]. A huge quantity of these produce goes waste due to lack of post-harvest loss like handling, storage, transportation and processing facilities (Shadanan, 1996) [7].

Tomato (*Lycopersicon esculentum* L.) is also called tomatokai/Ramulagakaya in Telugu, Tamaatar in Hindi, Tammato Hannu in Kannada, Takkali in Tamil and Malayalam. Tomato belongs to the family night shade (*Solanaceous*) which is categorized under order *Solanaled*, clade Tracheophytes, Genus Solanum, species S. Lycopersicon, and kingdom plantae (Thompson and Kelly, 1957) [12].

Tomato is a Solanaceous fruit vegetable, believed to have its origin in tropical America. The word tomato comes from the Spanish tomato, which in turn comes from the Nahuati word tomato meaning "the swelling fruit". Tomato was introduced in India by an English trader of the East India Company in 1882. Tomato is called as "Poor man's orange" due to good source of vitamin A, B and excellent source of vitamin C. It adds variety of color and flavor to the food and also rich in medicinal values. The fresh tomato fruits also contain 94.5% water, 3.9% carbohydrates, 1% protein, 0.1% fat and 0.5% mineral matter. (Dalia, 2012) [3].

A various unit operation such as washing, slicing, blanching and drying are preformed to prepare any value-added based products. Several unit operations for production of the drying, dehydrated and rehydrated products included blanching for inactivation of enzymes, drying and dehydration for removal of moisture content from the products.

Drying is the removals of moisture content from any products, different type of dryers was used for different products. Hot air oven is the one method of drying to use at a temperature of 105 °C for 24hrs, in tray dryer based on the products the temperature can be fixed. Typical products include a wide variety of value-added products from tomatoes. Different types of value-added products have been through processing of tomato.

Instant tomato powder provides convenience to consumers and assists in good health benefits with reducing the time of preparation. In this perspective, adoption of these different drying methods for development of different Instant Tomato powders.

Material and Methods

Procurement of Raw material

The red coloured matured tomatoes (PMR: 448) were procured from R. Anathapuram village, Sri Sathya Sai district, Andhra Pradesh. The detailed dimension of tomato *viz*., length, width, thickness, geometric mean diameter, arithmetic mean diameter, etc is explained in the Table1.

Plate 1: Ripened Tomatoes

Table 1: The detailed dimension of tomato

Properties	Mean values	Standard deviation
Length, mm	42.5325	3.56046
Width, mm	50.9855	4.768967
Thickness, mm	48.8135	4.850303
Geometric mean diameter (D_g), mm	47.469	4.037076
Arthematic mean diameter (D_a), mm	47.44	4087727
Equivalent mean diameter (D_e), mm	13.543	0.855604
Sphericity Index	23.629	5.131363
Surface area, mm^2	10115.23	1194.951

Development of Tomato Powder

Tomato powders are prepared with both blanched and unblanched tomatoes by using 4 different drying techniques namely sun drying, solar drying, hot air oven drying, and tray drying was used to dry the tomato slices. For each technique 1kg of tomatoes are used. Ripe tomatoes are subjected to hot water blanching at 90 ºC for 30 sec. Blanched tomatoes are peeled off and cut into slices (circular shape) of 0.5cm thickness and seeds are removed with hand. Keep the slices in both tray and hot air oven dryers at a temperature of 60ºC for 6hrs and 60 ºC for 26hrs. Later the dried material was ground by grinder to pass through 300µ mesh sieve.

Plate 2: Value-added products from tomato

Quality Analysis of Value - Added Products from Tomato

Proximate composition of value-added tomato products

Moisture content (%): The moisture content of the developed product samples and tomato powders were determined by following AOAC method (AOAC, 2005).The moisture content of the sample was calculated by using the following equation;

$$\text{Moisture content (\%)} = \frac{W_1 - W_2}{W_1} \times 100$$

Where,
W_1 = Initial weight of the sample, g
W_2 = Final weight of the sample, g

Total ash (%): The total ash content of the product samples and tomato powder were determined as per AOAC, 2005using muffle furnace. Accurately 3 g of the sample was weighed into a crucible (which was previously heated to about 585 °C and then cooled). The crucible was placed on a clay pipe triangle and heated first over a low flame till all the material was completely charred, followed by heating in a muffle furnace for about 3-5 h at 585 °C and for jam 6 h at 600 °C. It was then cooled in a desiccator and weighed. The percentage of ash was calculated by using the following expression;

$$\text{Total ash (\%)} = \frac{\text{Weight of ash (g)}}{\text{Weight of sample (g)}} \times 100$$

Determination of physical properties value added products of Tomato

Bulk density: Bulk density is typically measured by gently introducing a known sample mass into a graduated cylinder, and carefully levelling the powder without compacting it. The apparent untapped volume is then read to the nearest graduated unit, a 25-mL graduated cylinder filled at least 60% full calls for a sample mass of approximately 2–11 g. However, if a material is in short supply, a 10-mL graduated cylinder may used (Amidon and Mudie, 2017) [1]

$$\rho_{b\ (g/cc)} = \frac{\text{Mass of the sample}}{\text{Volume of the sample}}$$

Tapped density: The tapped density is obtained by tapping a 250 taps per minute by hand in a 10 ml graduated measuring cylinder containing the powder sample. After observing the initial powder volume or mass, the measuring cylinder is tapped and volume or mass readings are taken until little further volume or mass change is observed (Syed, *et al*., 2020) [11].

$$\rho_t(g/cc) = \frac{\text{Mass of the sample}}{\text{Minimum volume occupied after tapping}}$$

Where $\rho_t = Tapped\ density$

Determination of hydration properties of Tomato Powder

Flowability

Flowability was determined as the ratio of tapped density to the bulk density (Syed, *et al*., 2020) [11].

$$\text{Flowabality} = \frac{\rho t}{\rho b}$$

Where,
ρ_t=Tapped density, ρ_b=Bulk density

Carr Index

The Carr index is an indication of the compressibility of a powder. It is determined by ratio of difference of tapped and bulk density to tapped density (Syed, *et al*., 2020) [11].

$$\text{Carr Index} = 100 \times \frac{\rho t - \rho b}{\rho t}$$

Where ρ_t=Tapped density,ρ_b =Bulk density

Swelling capacity

Swelling capacity was determined according to Suresh *et al*, 2015. An accurately weighted 0.2g of tomato value added products was placed in a graduated conical tube. Around 10 ml of water was added and it was hydrated for 18 h at 25 °C. After this time, the final volume attained by the sample was measured. This assay was performed three times for each concentrate. Swelling capacity was calculated as using the following equation;

$$\text{SC (ml/g)} = \frac{\text{Volume occupied by the sample}}{\text{Original sample weight}}$$

Water absorption capacity

Water absorption capacity was determined according to Mawardii *et al*., 2017 [5]. An accurately weighted two grams of dried tomato sample powder was weighed (initial weight) into 250 ml beakersand 50 ml of distilled water was added at room temperature and kept aside for 2.0 hours and the water was filtered through filter paperuntil all the water was drained out and the stick water was removed by laboratory tissue paper and finally weight of water absorbed samples were taken (final weight). The water absorption capacities were determined according to the formula

$$\text{Water absorption capacity} = \frac{\text{Final weight of the sample - Initial weight of the sample}}{\text{Initial weight of the sample}}$$

Sensory analysis

An organoleptic evaluation of the product was done for color, flavor, texture, taste and overall acceptability (Ranganna, 1977) [6]. All the samples were displayed to the ambient conditions. Nine-point Hedonic scale was used for sensory evaluation and score card was given to bring out the inherent characteristics of tomato value added products. The value added tomato products was evaluated for color and appearance, texture, taste, flavor and overall acceptability in a distribution of cell on a 9-point Hedonic scale by a panel of 15 judges.

Results and Discussion

The determination of quality analysis for different tomato powdersare discussed here, quality analysis for Tomato Powder (tray dried tomato powder and hot air oven dried tomato powder).

Quality analysis of Tomato Powder

Moisture Content

The highest moisture content was observed in hot air oven dried tomato powder (5.79%), and lowest moisture content was observed in tray dried tomato powder (5.67%). Similar results were observed by Suresh and Smasher, 2013 for tomato powders. The results obtained for moisture content of different tomato powders (tray dried tomato powder and hot air oven dried tomato powder) graphically represented in Fig.1.

Ash Content

The value of ash content was found highest for tray dried tomato powder (17.72%) and lowest for hot air oven dried tomato powder (7.61%). The results obtained for total ash of different tomato powders (tray dried tomato powder and hot air oven dried tomato powder) graphically represented in Fig.2.

Bulk density

The results obtained for bulk density of different tomato powders (tray dried tomato powder and hot air oven dried tomato powder) graphically represented in Fig. 3. Highest bulk density was observed for tray dried tomato powder (0.43g/cc) and lowest bulk density for hot air oven dried tomato powder (0.38g/cc).

Tapped density

The value of tapped density was found highest for tray dried tomato powder (0.45g/cc). The lowest tapped density was obtained for hot air oven dried tomato powder of 0.4g/cc.

Table 2: Quality parameters for different Tomato Powders

S. No.	Products	Moisture Content (%)	Bulk density (g/cc)	Tapped density (g/cc)	Flowability	Carr index	Water absorption capacity	Swelling capacity (ml/g)	Ash content (%)
1.	Tomato powder (Tray dryer)	5.79	0.43	0.45	1.04	4.44	4.091	11.25	17.72
2.	Tomato powder (Hot air oven dryer)	5.67	0.38	0.40	0.91	3.49	1.803	11.46	7.61

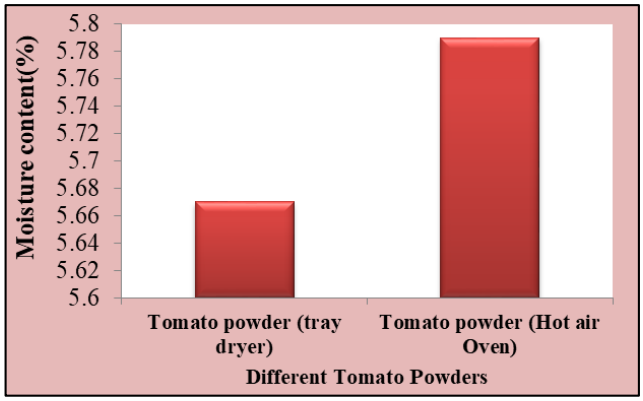

Fig 1: Moisture content of Tomato powders

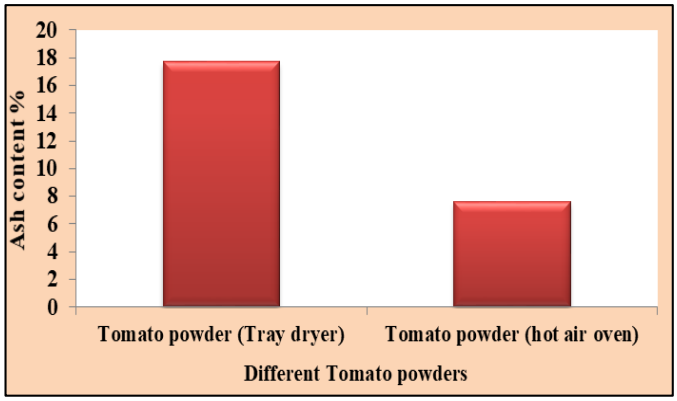

Fig 2: Ash Content of Tomato Powders

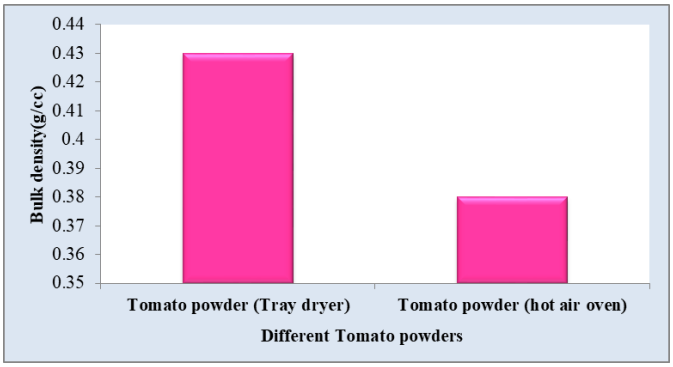

Fig 3: Bulk density of tomato powders

Flowability

Flowability of different tomato powders (tray dried tomato powder and hot air oven dried tomato powder) graphically represented in Fig.4. The results show that highest flowability was found for tray dried tomato powder (1.04). The lowest Flowability was obtained by hot air oven dried tomato powder (0.91). The final results of Flowability were within the recommended value by Sofia *et al.*, 2020 for different powders.

Carr Index

The results obtained for Carr index of different tomato powders (tray dried tomato powder and hot air oven dried tomato powder) graphically represented in Fig.5. The value of Carr index was found highest for tray dried tomato powder (4.44). The lowest Carr index for hot air oven dried tomato powder was 3.49.

Swelling capacity

Swelling capacity of different tomato powders (tray dried tomato powder and hot air oven dried tomato powder) graphically represented in Fig.6 The value of swelling capacity was found highest for hot air oven dried tomato powder (11.46) and lowest for tray dried tomato powder (11.25).

Water absorption capacity

Water absorption capacity of different tomato powders (tray dried tomato powder and hot air oven dried tomato powder) graphically represented in Fig. 7 and it is shown in Table 2. The value of water absorption capacity was found highest for tray dried tomato powder (4.091) and Lowes for hot air oven dried tomato powder (1.803).

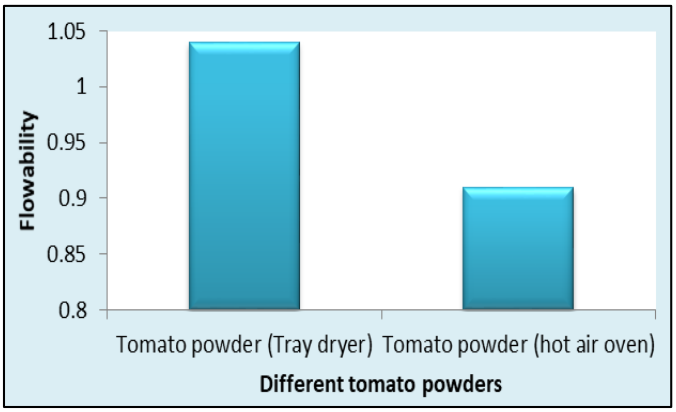

Fig 4: Flowability of different tomato powders

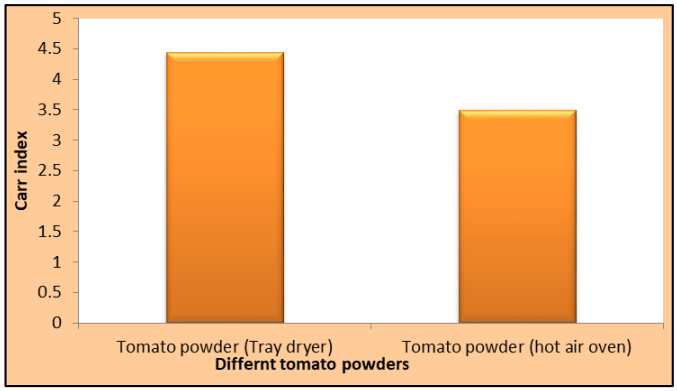

Fig 5: Carr index of different tomato powders

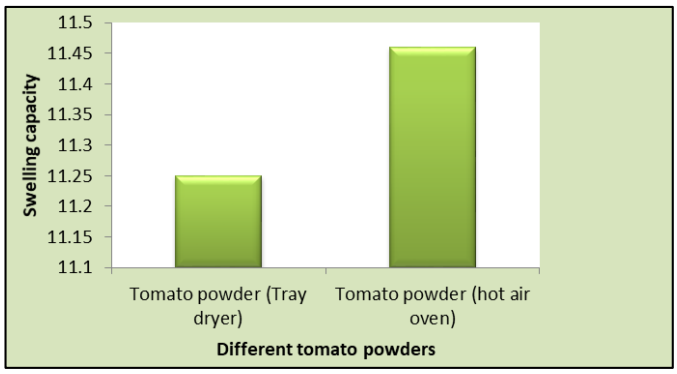

Fig 6: Swelling capacity of different tomato powders

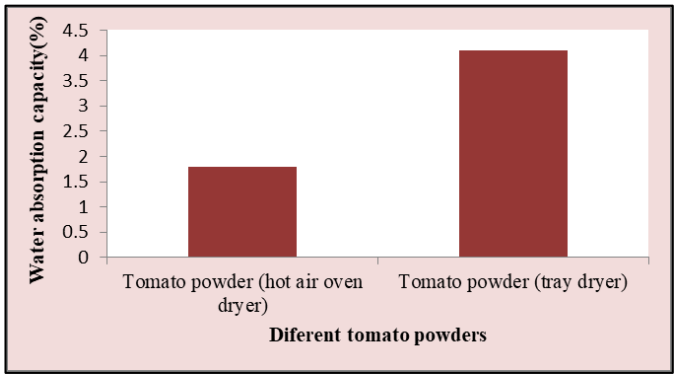

Fig 7: Water absorption capacity of different tomato powders

Conclusion

The drying and blanching method had a major role on production of Tomato powder from tomato. The quality of the powder mainly depends on the type of blanching, type of drying and temperature at which the operations carried out. The proximate composition of Tomato powder tomato *viz* Moisture content, ash content, bulk density, tapped density, flowability etc. had good quality and taste was observed in tray dried tomato powder. The powder obtained from tray drying gave good value to powder from tomato due to aroma, texture, taste and color which retains most of the functional components. The results showed that, the temperature during drying and blanching plays a major role in the production ofvalue-added products from tomato.

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