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Value added products from tomato: Quality analysis of different proximate, physical, hydrational and sensory analysis

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Abstract
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 colour and flavor to the food and also rich in medicinal values. The objective of our research is to development of different value-added products form tomato and analysis of quality parameters. Quality parameters for different value-added products from tomato like moisture content, ash content, bulk density, tapered density, flowability, Carr index, swelling capacity and sensory evaluation of different value-added product from tomato was analysed. The highest moisture content was observed in tomato jam (27.16%) followed by instant tomato rasam mix (4.67%), instant tomato sauce powder (4.6%), instant tomato pickle mix (4%) and instant tomato ketchup mix (3.37%) and from the sensory evaluation results, it was observed that higher sensory score for tomato jam (9.33) followed by instant tomato ketchup mix (9.0).

Keywords: Tomato, proximate, physical, hydrational, sensory analysis

1. Introduction
India has emerged as the second largest producer of fruits and vegetable in the world after Brazil and China (GOI, 2020) [5]. A huge quantity of these produce goes waste due to lack of post-harvest loss like handling, storage, transportation and processing facilities. The total losses of fruits and vegetables are estimated to be20-40 per cent amounting to nearly Rs. 30000 million per annum (Shadanan, 1996) [9].

The major tomato growing countries are China, USA, Italy, Turkey, India and Egypt. Tomato ranks third in priority after potato and onion. In India Andhra Pradesh, Karnataka, Madhya Pradesh and Telangana are the main tomato growing states produces 18% of tomatoes in the country with production of 3.4 MT from area of 170,000 ha and a productivity of 20 tons/ha. (*www.Indiastat.com*).

Tomatoes are significant source of umami flavor. Tomato is consumed in diverse ways, raw or cooked, in many dishes, sauce, salads and drinks. While tomatoes are fruits botanically classified as berries, they are commonly used as a vegetable ingredients or side dish. Tomato plants typically grow to 1-3 meters height. The size of the tomato varies according to the cultivar, with a range of 0.5-4 inches (1.3-10.2 cm) in width and it will vary based on the variety. (Salunkhe, 1974) [8].

The estimated post-harvest loss of the tomatoes was 25.5%. A realistic solution for reduction the postharvest loss f in fruits and vegetables is the adoption of the appropriate processing technologies. Numerous value-added products like pickles, curries, powder, jam, ketchup and some other products, are made from tomatoes. Nowadays with growing demands of different snacks around the world, products like instant tomato pickle, chips, sauce, powder and other dried food products are becoming more marketable. Value added product from tomatoes, with its unique sensory attributes are a popular variety of snacks served in various occasions, along with salt, sugar, spices and flavor.

Nowadays the development and consumption of RTE products through different drying and cooking has notably increased worldwide. Eating pattern are changing, snack foods play very important roles in the diet of the modern consumer. Many consumers do not have time to prepare traditional meals and increasingly even lack the knowledge of how to cook. In India, several value-added products, RTE and RTC products are available in market. The value-added products or foods prepared by blanching to inactivate enzymes, drying, cooking,

toasting, etc. (Dias *et al.,* 2009) [3]

Hot air oven is the one method of drying to used at a temperature of 105 ºC 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. Typical products include a wide variety of value-added products from tomatoes. Different types of value-added products have been through processing of tomato. Value added products like tomato jam, tomato pickle, tomato rasam powder, tomato ketchup mix, and tomato sauce powder. So, the product enriched with these raw materials *viz*. tomato, sugar, salt, spices, chillies, coriander, lemon, black pepper, cumin seed, dry ginger, tamper, fenugreek seeds, tamarind, etc., will ensure a food which is safe to consume, nutritious and convenient (Tripathi *et al.,* 2017) [13].

A value-added product from tomatoes 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 and different cooking methods for development of different value-added products from tomatoes.

2. Material and Methods

2.1 Procurement of Raw material

The red coloured matured tomatoes (PMR: 448) were procured from R. Anathapuram village, Sri Sathya Sai district, Andhra Pradesh.

2.2. Development of Different Value-added product from Tomato

1. Development of Tomato Jam

Tomato Jam was prepared by ripened red tomatoes, and it is free from the contamination. Tomatoes were peeled and then blanched at a temperature of 90 ºC for 30 sec. After blanched tomatoes were transferred to cold water, then added sugar syrup for tomato pulp and heated for 1h 15 min. During cooking, add table spoon of lemon juice and add pepper flakes. After getting definite consistency turn off the stove and transfer to glass bottle.

2. Development of Instant Tomato Pickle Mix (ITPM)

Whole ripe tomatoes were cleaned thoroughly with running water. Tomatoes were blanched and cut into pieces and dried in tray dryer at a temperature of 60 ºC for 6hrs. Later the dried material was grind by grinder to pass through 300 µ mesh sieve. Red chillies, cumin seeds and dry ginger in the proportion of 15:2:2 were grind in a grinder to pass through 300µ sieve to obtain a spice mix. Composition of spice ingredients were optimized by addition of spice mix, fatted white sesame meal and salt at 38:22:40 ratio. All the ingredients along with tomato powder were mixed and Instant tomato mix prepared.

3. Development of Instant Tomato Rasam mix

Tomatoes were thoroughly cleaned with water. Bowl of water placed on the stove and bring it to a boil. Tomatoes were dropped into the boiling water. Tomatoes were removed after 30 seconds of blanching or when the skin getting loose or shrink. After blanched tomatoes were kept in cooled water to cooldown immediately this prevents the tomatoes from cooking and getting too soft. Peel the outer skin and cut.

The cutted slices are dried in a tray dryer at temperature 60 ºC for 6hrs. Later the dried material was ground by grinder to pass through 300 µ mesh sieve. Roast the coriander seeds, pepper, cumin seeds, fenugreek seeds and Bengal gram separately on low flame. Roast the toor dal, red chilli and curry leaf in oil. Allow the roasted ingredients to cool. Grind all the dry roasted ingredients and tomato powder in a mixer. Mix the grinded mix and tamper. The prepared tomato rasam mix was stored in air tight container.

4. Development of Instant Tomato Ketchup Mix

Instant Tomato Ketchup Powder using dehydrated tomato powder and other spice ingredients had a greater advantage to employ the raw materials throughout glut seasons.

Tomatoes were thoroughly cleaned with water. Bowl of water placed on the stove and bring it to a boil. Tomatoes were dropped into the boiling water. Tomatoes were removed after 30 seconds or when the skin begins to peel.

After blanching the tomatoes were kept in cooled water to cool down immediately this prevents the tomatoes from cooking and getting too soft then remove the outer skin and cut into slice. Dry the slices in tray dryer at a temperature of 60 ºC for 6hrs. Later the dried material was ground by grinder to pass through 300µ mesh sieve. For Instant Tomato Ketchup Powder garlic, cinnamon, red chillies, cloves, salt, sugar were taken in proportions and ground into fine powder. The blanched dehydrated tomato powder is added to the spice grind powder. The prepared powder was packed in LDPE pouches for further analysis.

5. Development of Instant Tomato Sauce Powder

The fresh tomatoes were taken to clean with water to remove dirt and other contaminants. Bowl of water was placed on the stove to boil for a couple of minutes. Place the tomatoes in hot water for 30 seconds. After a couple of seconds of boiling the skin of the tomatoes were peeling out and look soft. Tomatoes were taken into the bowl of ice water. Peel was taken off and cut into slices. Slices were placed in a tray dryer at a temperature of 60 ºC for 6 hrs. The dehydrated tomato slices were ground into fine powder. Sugar and salt were taken and ground along with tomato powder. The final prepared instant sauce mix was packed in LDPE pouches for further analysis.

Plate 2: Value added products from Tomato

2.3 Quality Analysis of Value - Added Products from Tomato

2.3.1 Proximate composition of value-added tomato products.

2.3.1.1 Moisture content (%)

The moisture content of the developed product samples and tomato powders were determined by following AOAC method (AOAC, 2005).

2.3.1.2 Total ash (%)

The total ash content of the product samples and tomato powder were determined as per AOAC, 2005using muffle furnace. The percentage of ash was calculated by using the following expression;

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

2.3.2 Determination of physical properties value added products of Tomato

2.3.2.1 Bulk density

Bulk density of different value-added products are determined by using standard method by Amidon and Mudie, 2017 [1].

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

2.3.2.2 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) [12].

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

Where $\rho_t = Tapped\ density$

2.3.3 Determination of hydration properties of Tomato Powder

2.3.3.1 Flowability

Flowability was determined as the ratio of tapped density to the bulk density (Syed, *et al*., 2020) [12].

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

Where ρ_t=Tapped density, ρ_b=Bulk density

2.3.3.2 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) [12].

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

Where ρ_t=Tapped density,ρ_b =Bulk density

2.3.3.3 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 25ºC. 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;

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

2.3.3.4 Water absorption capacity

Water absorption capacity was determined according to standard method by Mawardii *et al*., 2017 [6]. The water absorption capacities were determined according to the formula

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

2.3.4 Sensory analysis

An organoleptic evaluation of the product was done for color, flavor, texture, taste and overall acceptability (Ranganna, 1977) [7]. 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.

3. Results and Discussion

3.1 Quality parameters of value-added tomato products

3.1.1 Moisture content

The results obtained for moisture content of different value-added products from tomato (instant tomato pickle mix, instant tomato rasam mix, instant tomato ketchup mix, instant tomato sauce mix, tomato jam) graphically represented in Fig. 1 and its details shown in Table. 1. The highest moisture content was observed in tomato jam (27.16%) followed by instant tomato ketchup mix (4.98%), instant tomato rasam mix (4.67%) and instant tomato sauce powder (4.6%). Lowest moisture content was observed in instant tomato pickle mix (4%). Moisture content of different value-added tomato powder was varied from 4 to 5.8 and it was within the range of 4 to 8%. The similar results were observed from Suresh and Smasher, 2013 for tomato powder. For tomato jam moisture content was within the range that is recommended from Emelike and Akusu, 2019 [4] for tomato jam.

3.1.2 Total ash (%)

The results obtained for total ash of different value-added products from tomato (instant tomato pickle mix, instant tomato rasam mix, instant tomato ketchup mix, instant tomato sauce mix, tomato jam) graphically represented in Fig. 2and it is shown in Table.1. The value of ash content was found highest for instant tomato rasam mix (49.50%) followed by instant tomato pickle mix (29.13%) and instant tomato ketchup mix (17.39%) and instant tomato sauce powder (0.66%). Lowest ash content was observed in tomato jam (0.62%) and ash content for tomato jam is within the range of 0.19 to 0.82%.

3.1.3 Bulk density

The results obtained for bulk density of different value-added products from tomato (instant tomato pickle mix, instant tomato rasam mix, instant tomato ketchup mix and instant tomato sauce mix) graphically represented in Fig. 3. Highest bulk density was observed for instant tomato pickle mix (0.66g/cc) followed by instant tomato rasam mix (0.59g/cc) and instant tomato sauce mix (0.5g/cc). The similar results were observed in different powders that are recommended by Yuvaraj *et al.*, 2015 [15] of bulk density 0.533 g/cc. The lowest bulk density was found in instant tomato ketchup mix (0.48g/cc).

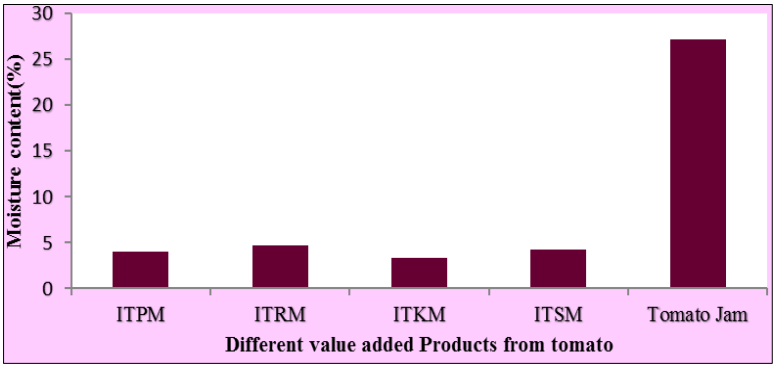

Fig 1: Moisture content of different value-added products from tomato

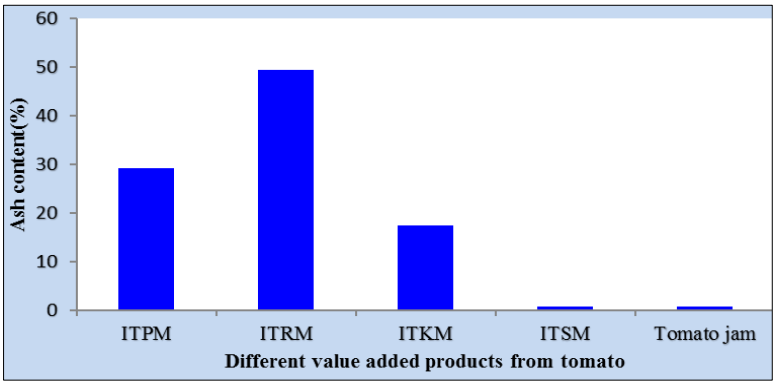

Fig 2: Ash content of different value-added products from tomato

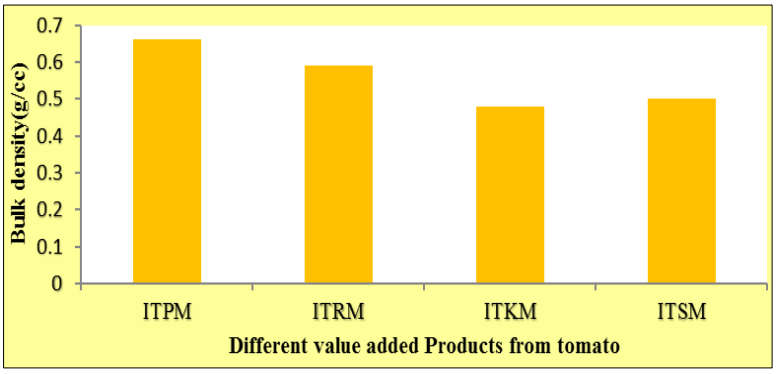

Fig 3: Bulk density of different value-added products from tomato

3.1.4 Tapped density

Final results observed that tapped density of different value-added products from tomato *viz*, instant tomato pickle mix, instant tomato rasam mix, instant tomato ketchup mix and instant tomato sauce mix is graphically represented in Fig.4 and its details shown in (Table.1) The value of tapped density was found highest for instant tomato pickle mix (0.87g/cc) followed by instant tomato rasam mix (0.65g/cc) and instant tomato ketchup mix (0.56 g/cc). The average tapped density value was found in tomato powders by Yuvaraj *et al.*,2015 [15] of 0.638 g/cc. The lowest tapped density was obtained for instant tomato sauce mix (0.55g/cc).

3.1.5 Flowability

Flowability of different value-added products from tomato *viz*., instant tomato pickle mix, instant tomato rasam mix, instant tomato ketchup mix and instant tomato sauce mix is graphically represented in Fig.5and its details shown in (Table.1). The results show that highest Flowability was found for instant tomato pickle mix (1.31) followed by instant tomato ketchup mix (1.15) and instant tomato sauce mix (1.09). The lowest Flowability was obtained by instant tomato rasam mix (1.09). The final results of Flowability were within the recommended value by Sofia *et al.*, 2020 [10] of 1.2-1.4 for different powders.

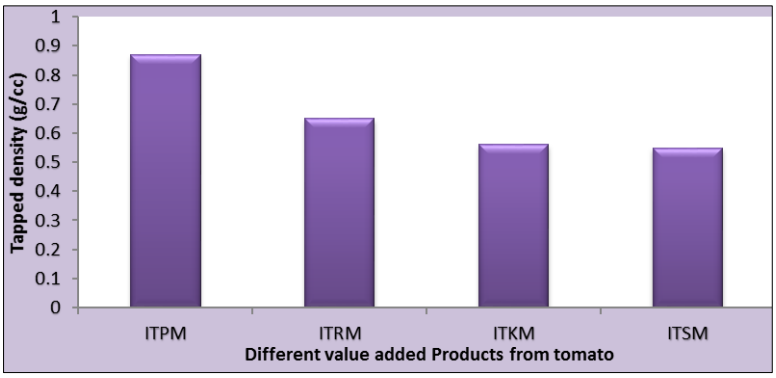

Fig 4: Tapped density of different value-added products from tomato

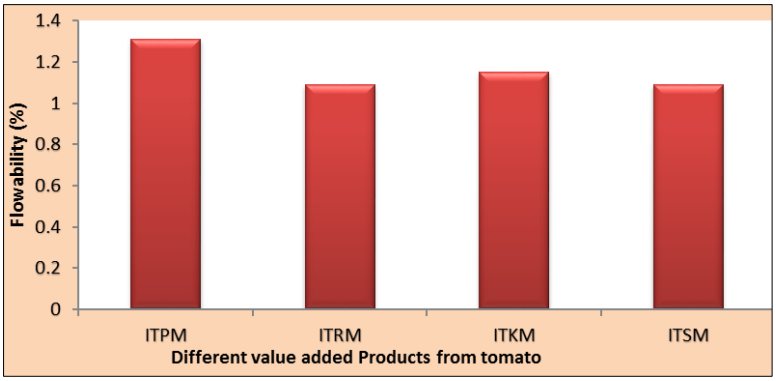

Fig 5: Flowability of different value-added products from tomato

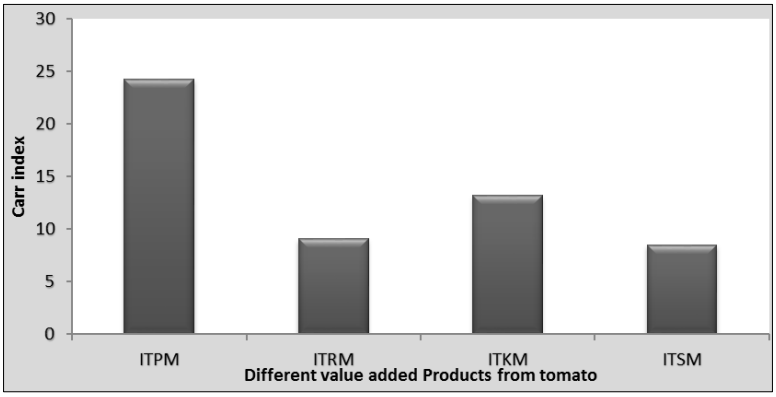

Fig 6: Carr index of different value-added products from tomato

Table 1: Quality parameters for different value-added product from tomato

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	ITPM	4	0.66	0.87	1.31	24.29	0.326	6.17	29.139
2	ITRM	4.67	0.59	0.65	1.09	9.07	1.603	5.16	49.501
3	ITKM	3.37	0.48	0.56	1.15	13.21	0.1316	7.41	17.391
4	ITSM	4.3	0.50	0.55	1.09	8.5	0.02	3.15	0.664
5	Tomato jam	27.16	_	_	_	_	_	_	0.62

ITPM – Instant Tomato Pickle Mix, ITRM – Instant Tomato Rasam Mix,
ITKM – Instant Tomato Ketchup Mix, ITSM – Instant Tomato Sauce Mix

3.1.6 Carr Index

The results obtained for Carr index of different value-added products from tomato (instant tomato pickle mix, instant tomato rasam mix, instant tomato ketchup mix and instant tomato sauce mix) is graphically represented in Fig.6and its details shown in Table 1. The value of Carr index was found highest for instant tomato pickle mix (24.29) followed by instant tomato ketchup mix (13.21) instant tomato rasam mix (9.07). The lowest Carr index for instant tomato sauce mix (8.5). The similar results were observed of Carr index by Syed *et al.*, 2020 of 12.82%.

3.1.7 Swelling capacity

Swelling capacity of different value-added products from tomato (instant tomato pickle mix, instant tomato rasam mix, instant tomato ketchup mix, instant tomato sauce mix) is

graphically represented in Fig.7and its details shown in Table 1. The value of swelling capacity was found highest for followed by instant tomato ketchup mix (7.41) followed by instant tomato pickle mix (6.71) and instant tomato rasam mix (5.16). The lowest swelling capacity was observed in instant tomato sauce mix (3.15) because when sauce mix was dissolved in water. The near swelling capacity value was observed for flours of 15.2 to 42.9 ml/g (Suresh *et al.*, 2013).

3.1.8 Water absorption capacity

The value of water absorption capacity was found highest for instant tomato rasam mix (1.603) followed by instant tomato pickle mix (0.326), instant tomato sauce mix (0.02). The lowest water absorption capacity was observed for instant tomato ketchup mix (0.1316). The similar results were observed for tomato powder in the range of 2.4 to 3.4 by Mawardii *et al.*, 2017.Water absorption capacity of different value-added products from tomato (instant tomato pickle mix, instant tomato rasam mix, instant tomato ketchup mix and instant tomato sauce mix) is graphically represented in Fig.8and its details shown in Table 2.

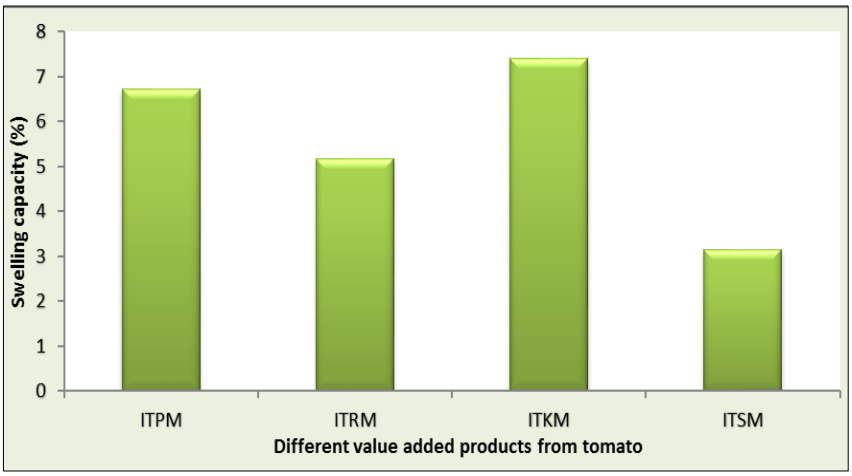

Fig 7: Swelling capacity of different value-added products from tomato

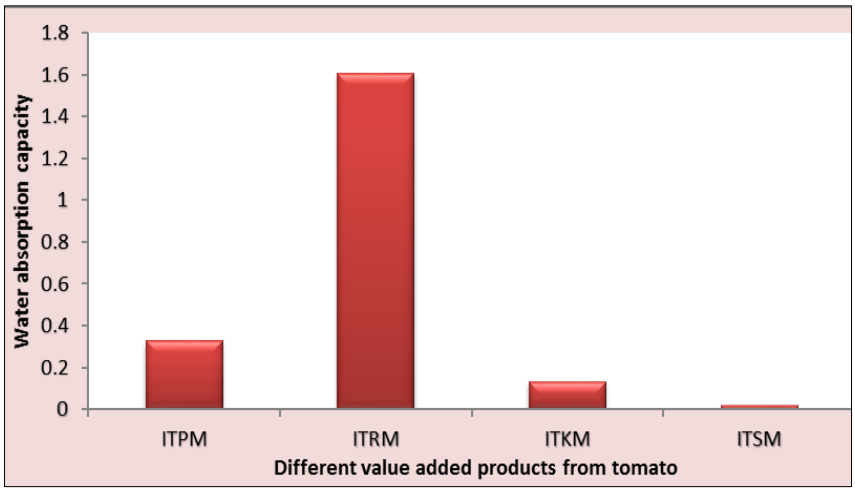

Fig 8: Water absorption capacity of different value added from tomato

3.2 Sensory Analysis

The sensory evaluation was carried out on the basis of color, texture, flavor, taste and overall acceptability of the developed pasta product. Sensory evaluation of different value-added products from tomato (instant tomato pickle mix, instant tomato rasam mix, instant tomato ketchup mix, instant tomato sauce mix and tomato jam) is graphically represented in Fig. 9and its details shown in Table 2. The tomato jam (9.33) got higher sensory score followed by instant tomato ketchup mix (9.0), instant tomato pickle mix (8.6), instant tomato sauce mix (8.4) and instant tomato rasam mix (8.4).

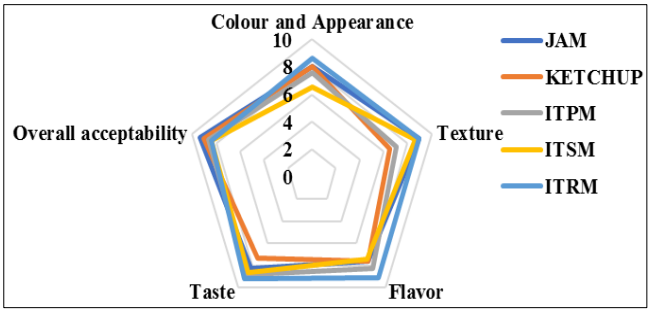

Fig 9: Sensory Scores for different value-added products from tomato

4. Conclusion

Some fruits and vegetables are perishable in nature, some of the vegetables will available only on seasonal basis. To adopt the particular technology to increases the shelf life of the products. The drying and blanching method had a major role on production of value-added products from tomato. The proximate composition of value-added products from tomato *viz.*, moisture content and ash content were found to be good in instant tomato pickle mix and instant tomato Rasam mix as compared to remaining value-added products from tomato (instant tomato ketchup mix, instant tomato sauce mixand tomato jam).In case of hydration properties *viz.*, flowability, Carr index, swelling capacity and water absorption capacity were found to be high in instant tomato pickle mix as compared to remaining value-added products from tomato (instant tomato ketchup mix, instant tomato sauce mix and tomato jam). Similarly, with respect to physical properties *viz.*, bulk density and tapped density were found to be good in instant tomato ketchup mix.These methods adversely affect the quality of value-added products from tomato.

Table 2: Sensory Scores for different value-added products from tomato

Products	Colour and Appearance	Texture	Flavor	Taste	Overall acceptability
JAM	8	8.9333	7.6	8.27	9.3333
KETCHUP	8	6.5333	7.6	7.33	9.0667
ITPM	7.6	7.0667	8.267	8.8	8.6667
ITSM	6.53	8.6667	7.467	8.67	8.4
ITRM	8.67	8.9333	9.067	9.2	8.4

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