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Development of methodology for the production of tomato powder and evaluation of antioxidant activity of tomato powder

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Abstract
Tomato (Solanum lycopersicum) is a vegetable as well as fruit. Tomato contain many vitamins and minerals that are essential for healthy life. The important content like fiber, potassium, choline and folate that are support heart health and minimize the risk of cardicascular and many type of cancer or other diseases e.g. diabetes, blood pressure, eye diseases. Tomatoes are sensitive to extreme heat, humidity, insects and many other environmental hazards so pre or post-harvest loss of tomatoes occur. Increase the shelf life of tomato or for long-term use of tomatoes, tomatoes converted into powder form by use unique or fast technique that is spray dryer. Then different analysis of powder was done.

Keywords: solanum lycopersicum, spray dryer, arabic gum, antioxidants activity

1. Introduction

The tomato (Solanum lycopersicum) lies in family Solanaceae that is diverse family because it contains more than 3000 different species over a valid range of territory. Physical structure of tomato consists of 56% of plup and skin 44% seeds. Tomatoes have grate economic importance either because of their consumption a raw form or in several productions such as juices, purees, paste and different cocked food. Sketch up made up of tomatoes in ancient time use as a medicine. Approximately 17.6 million tons of tomatoes produced by The European Union, has been reported in 2015 [1].

Tomatoes are rich source of vitamins A and C, lycopene, magnesium, iron, riboflavin, potassium, phosphorus, beta-carotene deitry fiber, naicin and thiamin. Tomatoes are low in fat content because its supplies low level of saturated fat, cholesterol and sodium. Tomatoes also shows bioactivity because of presences of phenolics compound lycopene and carotenoid. In processed foods ascorbic acid, tocopherol, freeze –dried antioxidant, thermolabile lycopene and phenolic compound are present these are bioactive compound. Heat treatment shows least effect on the main antioxidant [2].

Quercetin, chlorogenic acid and naringenin are the main phenolic section in tomatoes. Lycopene is an antioxidant, which have the potential to harmonize the body immune system, secretion as well as metabolic pathway [3]. The consumption of tomatoes have beneficial role against cardiovascular disease and different types of cancer [4]. Tomatoes are contain highly effective phytochemical especially lycopene that are used to slender oxygen species and have capacity to inhibit damage to cell control, antioxidants are very effective against oxidative stress [5].

Tomatoes are taken with different vegetables as a salad. It is used in sandwiches, or as stewed, fried and baked with other vegetables. Tomatoes' are necessary ingredient using in pasta, hot dogs,pizza, and hamburger and in many other foods. It is well off with minerals, nutrients and calories and excellent source of vitamins A, B, C and iron [6,7].

People eat tomatoes in diverse form throughout the year. Tomato is quite palatable, freshen and have a good taste. Tomatoes will use as it is or in cooked formed along other vegetables. Tomatoes restrain 94% water content and good source of healthful vitamins or minerals. 15% and 40% of daily dose of Vitamin A and Vitamin C obtain from tomatoes. Furthermore, tomatoes having lycopene a red color pigment that is use as antioxidant. Antioxidants capable for neutralizing free radicals, Free radicals are those that can damage cells in the body. Antioxidants stop the breast, lungs and endometrial cancer cells; it can also diminish the risk of prostate cancer by 45%. Despite that within the season marketing of fresh tomatoes is a serious problem due to tomatoes short postharvest life, it is sensitive fruit that drive huge postharvest casualties. There are almost 54% postharvest tomatoes losses are recorded. Short shelf life of tomatoes coupling along unsatisfactory handling facilities consequence a huge loss of revenue of the country. For this reason, advancement of preservative method is helpful for farmers producing massive quantities of tomatoes. By using concentrating pulp, juice diverse range of tomatoes products are produce, that require higher costs techniques for excellent characteristics product. Hence, today most important requirement of revival market is to develop cheap cost manufacturing and packing methods for production of ease and shelf life stable products. So drying is easy or much adequate technique for full fil all necessary requirements. Therefore, this research is conducted to develop dehydrated tomato powder and check out the antioxidant activity of tomato powder [8].

There are many different drying techniques, but mostly spray dryer is used to form powder of fruits juices. Powder or agglomerates are produced by dehydrate different products through spray dryer in food industries. Yield of fruits powders are mainly depending on different parameters that is feed flow rate, addends, concentration of juices, inlet temperature or out let temperature [9].Different drying materials such as Arabic gum, Starch and malt dextrin are used to produce spray dried powder. Drying agent is used because fruits powder is hygroscopic [10].

Fruit powder with specific moisture content or particle size

is produce by a unique technique that is spray dryer regardless of product drying capacity and product that is sensitive to heat. In spray drying process powder making system is followed by a steam line process which involve liquid feed into drying camber before passing in atomizer system, after that liquid drops trap into steam heater gas which is used for final product recovery. After trapping into a steam of heater gas the powder cool down by cold droplets of water, so the evaporation has occurred for a few seconds by the contact of hot gas and cold droplets of water. Less than 6% solid content are present in tomato, but for the preceding of spray drying tomato-pulped form past, that must contain 30% solid content by evaporation [11]. The tomato powder which has specific properties like stability, as natural and easily dissolvable ingredients give much importance in wide range of uses in different production give the specific color, taste and aroma to the product. Antioxidants are obtain from tomatoes have potential to use in different products. Total phenolic anti-oxidant activity and 2, 2-diphenyl-1-picrylhydrazyl (DPPH) are used to find extracted anti-oxidant potential. Oxidation process in food is prevented by using flavonoids that have the anti-oxidant activity. Lipid peroxidation present in different food products that destroy their quality by producing free radicals and relative oxygen species (ROS) have also negative consequences to human health. Phenolic compounds are essential because they have wide range of physiological chemical functions such as anti-microbial, cardio-pulmonary vasodilator, anti-oxidants, anti-allergens, anti-thrombotic and antiatherogenic [12].

There are various techniques are present that are used to stop spoilage of fresh fruits. Enzyme activity and microbial growth increase in fruits that have high water contents this may cause deteriorative effect on quality of fruits. By minimizing moisture content and water activity in fruits have positive influence on the quality. As ancient time, there were many techniques to less the water content like sun drying, heat drying as well as smoking. The product quality as well as yield of product was increased by using different drying technique etc freeze drying, tray drying and spray drying [13].

The refined quality product obtained through spray dryer, this is the main reason for adopting spray drying technique. Hygroscopicity, moisture content, bulk density, solubility are the most common quoted specification. Tomato powder properties have positively influenced by drying condition experienced by drop during drying [14].

2. Material and Methods

2.1 Methods

Tomatoes plup was use for preparation of tomato powder with different treatments 0%,10%, 15% and 20%. Prepared powder was pack in glass airtight jars or sealed packets. Temperature ranges 160, 170, and 180. Tomato powder was subjected for analysis Titratable acidity, Antioxidant, Total phenols and Wettability.

2.2 Procurement and preparation of raw material.

Fresh tomatoes and other ingredient like carrier agent were procured from local market of Lahore, Punjab. Technique use for selection of samples were simple randomly sampling technique. The study was conduct at Food sciences and technology Lab# 102, University institute of diet and nutritional sciences, Faculty of Allied health science, The University of Lahore.

After purchasing tomatoes were manually washed with running water to remove dust and other impurities.

2.3 Preparation of Tomato powder

Electric blender is use to make paste of tomatoes then sieve the plup to remove debris. Take Sieved plup add carrier agent 0, 0, 7.5 and 15 g/100ml with different flow rate 0%, 10%, 15% and 20% flow rate and run machine at temperature 160 ºC, 160 ºC, 170 ºC and 180 ºC. Spray dryer is use to convert pulp into powder. Pulp run into machine and a glass jar is attached into other side of machine in which fine powder is collected.

2.4 Analysis of Tomato powder

The prepared powder is pack in airtight jar or in sealed packets and analysis for following parameters.

2.5 Titratable acidity

Titratable acidity was determined by using 0.1 N NaOH sodium hydroxide. Phenolphthalein use as an indicator. Titratable acidity is measure by using AOAC [15].

2.6 Antioxidant activity

Antioxidants are that compounds which were used to stop oxidation. Oxidation is a chemical reaction in which free radicals are produce that can damage organism's cell. Ascorbic acid, thiols are commonly used as antioxidants.

2.7 Preparation of Antioxidant Extract

Extract of tomato powder was prepared by using solvent extraction method. Take 20g tomato powder added 180ml ethanol in a flask and placed on orbital shaker for overnight at 280rpm for complete mixing. Place the sample in centrifugation tubes and centrifuge at 7000rpm for 15min at 4ºC.The supernatant was removed and solvent was extracted by using rotary evaporator at 78ºC. The resultant extract was stored in a refrigerator for further analysis.

Free Radical Scavenging Activity (DPPH assay)

The free radical scavenging activity of extract was measured by using DPPH. For this purpose, DPPH solution was prepared. Take 2.5g DPPH in 100ml methanol in 250ml beaker. Spectrophotometer (CECIL CE7200) was used for free radical scavenging [16]. After that take 2950 µL DPPH form freshly prepared DPPH solution then add 75 µL sample tomato extract. Sample was kept in dark place for 30min at room temperature. Then put the sample in cubic tube and run the sample in spectrophotometer at 517nm wavelength. Similarly, blank sample of same amount was also run in spectrophotometer at same wavelength.

Formula used for this is mentioned bellow

Percentage Reduction of absorbance

$$\% = [(AB - AA) / AB] \times 100;$$

where AB = absorbance of blank sample at t = 0 min

AA =Total absorbance of tested extract solution at t = 30 min.

2.8 Total Phenolic Content TPC

Total phenolic content was determined by using Folin ciocalteu method. Accordingly, take 125 µL tomato powder extract add 125 µL Folin ciocalteu reagent then add 500 µL distilled water and give five mint stay time at room temperature, after that 4.5 ml 7% sodium bicarbonate was

added in solution. Absorbance was measured at 765nm wavelength through Spectrophotometer (U-2900UV/VIS, HITACHI, Japan) against control [17]. Total phenolic was recorded and value were computed Gallic acid equivalent.

2.9 Wettability
Wettability is time required of powder deposited on liquid surface to submerge completely. For measuring wettability of tomato powder take 250ml beaker add 100ml water then put 1g sample. Note the time for sample to become wet completely [18].

3. Results and discussion
3.1 Titratable acidity
Titratable acidity of T0 is 5.81%, T1 6.64%, T2 7.5% and T3 6.7%. Titratable acidity of Tomato powder is 7.5% is highest. The lowest titratable acidity 5.81% having zero concentration of drying agent. Another study showed same results in which T2 showed 7.30% and T3 showed 6.59% titratable acidity. Titratable acidity is use to determine the perceivable amount of acid in a product.

Table 1: of Titratable acidity of tomato powder

Treatment	Mean
T0	5.8133^{A}
T1	6.6400^{A}
T2	7.5167^{A}
T3	6.7333^{A}
Mean	26.703

3.2 Antioxidant activity
DPPH scavenging capacity assay
Tomato has a strong potential to scavenge the free radicals. The results for the DPPH of the tomato powder show that DPPH of T0 is 58.66%, T1 63.00%, T2 65.33% and T3 68.00%. Highest value of DPPH was 68.0% was notes. The lowest value is 58.66 and mean value was 255.0. In a same manner Shabnam *et al*, conducted a study to evaluate antioxidant potential of tomato powder, results of DPPH assay revealed that ethanoic extract showed highest percentage (58.4±2.6 %) of DPPH assay in T4 while water extracts showed lowest percentage (33.8±3.4 %) in T1 [19].

Table 2: of DPPH scavenging assay

Treatment	Mean
T0	58.667^{A}
T1	63.000^{A}
T2	65.333^{A}
T3	68.000^{A}
Mean	255.0

3.3 Total phenolic contents (TPC)
The results for the TPC of the tomato powder show that TPC of T0 is 1.94 mg GAE/g, T1 2.08 mg GAE/g, T2 2.15 mg GAE/g and T3 2.15 mg GAE/g. Same study was conducted by another researcher in that study results of TPC in T0 was 1.81 mg GAE/g, T1 2.12 mg GAE/g, T2 2.18 mg GAE/g and T3 2.20 mg GAE/g which are very similar to the results of this study.
Highest value of total phenolic content was 2.15 that was noted in T2 and T3. The lowest value is noted in T0. Mean value was 8.3283.

Table 3: of Total Phenolic Contents (TPC) of Tomato Powder (mg GAE/g)

Treatment	Mean
T0	1.9433^{A}
T1	2.0800^{A}
T2	2.1500^{A}
T3	2.1550^{A}
Mean	8.3283

3.4 Wettability
Immersion of the powdered product sprinkled on the surface of a liquid at 25°C. The results for the wettability of the tomato powder show that wettability of T0 is 58.33%, T1 55.66%, T2 59.00% and T3 53.33%. Highest rate of wettability is 59.00% at concentration treatment T_2. The lowest wettability is noted in T_1 treatment that is 55.66% and mean value is 226.33. In another study conducted on same pattern results of weatbility were matching with these results which were in T0 56.23%, T1 55.99%, T2 58.10% and T3 52.31%.

Table 4: of Wettability of Tomato Powder (%)

Treatment	Mean
T0	58.333^{A}
T1	55.667^{A}
T2	59.000^{A}
T3	53.333^{A}
Mean	226.33

4. Conclusion
Tomatoes contain high content of minerals, vitamins, lycopene, antioxidant and deitry fiber that are important for curing many diseases. By converting tomatoes into tomato powder tomatoes cannot loss its nutritional benefits. According to research, 200 grams of tomato (or about 1.5 medium tomatoes) each day reduced blood pressure in people with type-2 diabetes. Using drying agent and different operating parameters yield of tomatoes increase. Tomatoes shows high antioxidant activity.

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