Influence of Different Drying Techniques on Dehydrated Tomato Powder

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Abstract:This study is focused on different drying methods of dehydrated tomato powder. Tomato were selected and collected according to their uniform size, freshness and cleanliness (free from dirt, twigs, soil, dust etc). The sample was packed in polyethylene bag and stored at refrigeration temperature in airtight box at the laboratory until use. The slices of tomatoes were used for different treatments such as sun drying, Oven drying, Vacuum drying, Spray drying. The best blanching and drying treatments were evaluated based on the physio-chemical analysis and organoleptic properties of the dried product. Effects of drying methods on the values Physico-chemical properties of dehydrated tomato powder like, Moisture content, Protein Content, Fibre,..etc was determined in Spray dried dehydrated tomato powder and sun dried tomatoes followed these samples.

Keywords; **Tomato, sun drying, oven drying and spray drying.**

I. INTRODUCTION

Tomato (Lycopersicumesculentum) is an herb that falls within the nightshade family. A Post harvest loss in tomato is a major problem in the market supply chain of small farm holders in India. Drying is one of the effective post-harvest technology used for making tomato powder of long shelf life. It is grown in all latitudes, over an area of approx. 3,000,000 hectares, which represents almost one-third of the world's largest land used for growing vegetables and constitutes one of the most important crops in the food industry. Tomato is very liable to perish in the fresh state, which leads to wastage. Current statistics indicate 20-25 % of pathogenic post-harvest losses in developed countries in developing countries they lose more than 35 % due to inadequate storage, processing, therefore, a correct post-harvest treatment can prolong the shelf life. Drying is one of the oldest and most effective means of preserving food. Dry food can be successfully stored for up to several years if it is properly packed. Drying in the Sun drying, Oven drying, Vacuum drying, Spray drying is known as a food preservation process, which reduces the moisture content of agricultural products, and thereby prevents damage during storage. This technique has the advantage of simplicity and small. Drying is a complex process in which transient heat and moisture occur at the same time. In recent years, various authors have conducted many studies involving drying process of fruits and vegetables, such as red pepper, eggplant, green beans, okra, leafy vegetables and tomatoes. The aim of this study is to describe drying of thin sliced tomato in the conditions of different techniques. In last year's, the interest in dried tomato products is increasing since their use as ingredients for pizza and various vegetable and spicy dishes became popular (Marfil et al., 2008). Fruits, vegetables, and their products in the dried form are good sources of energy, minerals, and vitamins. However, during the process of dehydration there are changes in quality parameters in dried products. One of the major quality parameters associated with dried food products are color (Krokida et al., 1998). The color retention influences its preference, prices, and ultimately acceptability (Cui et al., 2004). The products are prepared from Spray dried powder are Tomato twist, pink cubes, tomato leather, tomato samber powder tested for color, taste, texture and overall acceptability. The processing parameters were successfully established in this study to minimize changes in quality attributes. The same reflected in the mean preference scores of 15 panelists. The estimated medians for odour, texture, taste, color and overall acceptability of the 4 point "like very much" which corresponds to number 4 of the point Hedonic scale. The purpose of this study was to determine the influence of different drying process, (sun drying, Oven drying, vacuum drying and Spray drying). Color is perhaps the most important sensory or acceptability attribute of food products and many food producers utilize the psychological effect of color to enhance their products because abnormal colors, especially those associated with deterioration in eating quality or with spoilage, cause the product to be rejected by the consumer (Lopez et al,. 1997; Waliszewski et al., 1999).

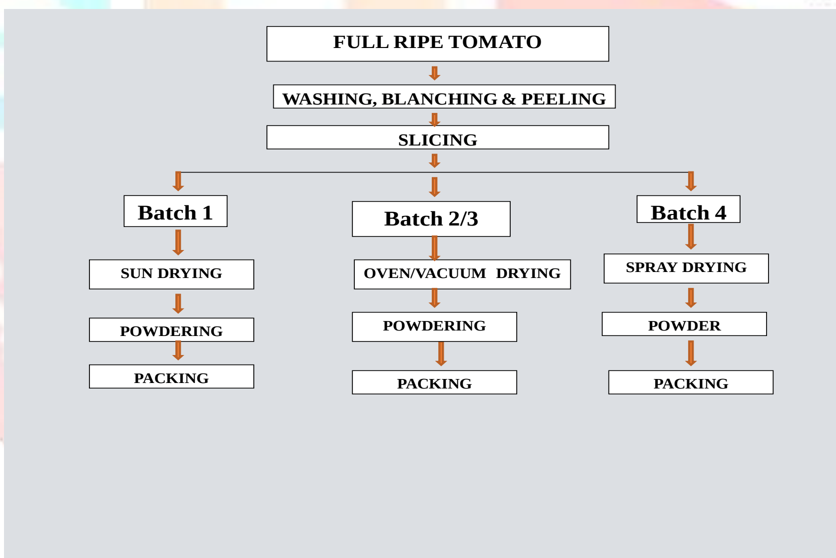
II. MATERIALS AND METHODS

2.1 Collection of Raw material

The research was conducted in the Department of Food Science and Technology, Agricultural College, Hassan. Ripe tomatoes were collected from the farms near Shathigrama village of Hassan District and used for the experiments. They were selected and collected according to their uniform size, freshness and cleanliness (free from dirt, twigs, soil, dust etc).The sample was packed in polyethylene bag and stored at refrigeration temperature in airtight box at the laboratory until use.

2.2 Development of Processing Parameters

The cleaned and washed ripe tomatoes were blanched at 85˚C for 1 minutes followed by stripping the skin and cut into slices of 1/8th" thickness. The slices of tomatoes were used for different treatments such as sun drying, oven drying and spray drying. The best blanching and drying treatments were evaluated based on the physio-chemical analysis and organoleptic properties of the dried product.



2.3 Sun drying experiments;

Perforated sample trays were used in sun drying experiments (Figure T1). These trays were assembled to wooden frame in the size of 80x100 cm on 80 cm stands to prevent from contamination. During the drying of tomato slices, the ambient air temperature, relative humidity and wind speed values were determined between 28- 34.8°C, 32.20-40.50%, 0.4-2.9 m/s, respectively. Open sun drying experiments were done between 09:30 and 18:30.

Fig.1 Drying methods and performing of drying processes: T1: Sun drying; T2:Oven drying; T3: Vacuum drying; T4: Spray drying

2.4Oven drying experiments (OD);

Oven drying experiments was carried out in a hot air drier (Figure T2) designed and constructed in the Department of Food Science and Technology,Hassan. The drying chamber was constructed from galvanized metal sheets. Two electrical heaters were inside chamber used to provide the hot air. ARM 396 analogue heat control unit with digital indicator was used to determinate of air temperatures. The airflow rate was measured by anemometer in the measurement range of 0.4-30 m/s. Oven drying experiments were performed at drying temperature that were 65°C and air velocities were adjusted as 1.5 and 2.5 m/s in oven air drying experiments.

2.5 Vacuum drying experiments (VD);

The vacuum drying process was conducted in MMM MedcenterVacucell 22 Blue Line Vacuum Dryer that have 22 liter capacity stainless steel chamber (Figure T3). Vacuum drier is connected with Diaphragm Vacuum Pump. This pump can be reached the value of 75 mmHg ultimate vacuum. Drying experiments were carried out at the drying temperature of 65°C and vacuum chamber pressure of 10 kPa.

2.6 Spray drying experiments (SD);

The drying was carried out in an ACMEFIL make spray drier (5 kg output capacity/hour). The main components of the drier were the feed system, air compressor with blower, rotary disk atomizer, cyclone and peristaltic pump. The feed system of drying air constituted of a blower and an air filter. The process steps comprise: (a) Pre treating fruits for 3 minutes in Hot water 60^{0}C & blanching. (b) Collecting fruit pulp & filtering. (c) Addition of water soluble drying aid – Malt dextrin. (40gm/ lit of pulp) (d) Controlled flow of juice in to the atomizer (pump setting 80ml /min). (e) Controlled inlet and outlet air temperature of the spray dryer. (e) Collection of powder from the cyclone and bottom outlet.

2.7 Analytical Methods;

Following methods was applied to tomatoes after dehydrated tomato powder;

Moisture, total ash, crude protein, crude fat and crude fiber content of the fresh dehydrated tomato samples of different drying techniques were determined in triplicates according to the standard methods of AOAC (1990).

2.8 Statistical analysis

Data were analysed using SPPS for Windows 10. The statistical significance of the observed difference among the means of triplicate readings of experimental results obtained were evaluated by analysis of variance (ANOVA) at 5% level of significance.

III RESULTS AND DISCUSSION

3.1Physico-chemical properties of dehydrated tomato powder

3.1.1 Moisture content

The Moisture content of Fresh tomato (FTS), Sun dried powder (SDP),Oven dried powder (ODP), Vacuum dried powder (VDP), Spray dried powder (SPP) from alankar variety was 92.5%, 7.5%,10.9%,6.11%, 5.11% respectively as shown in Fig 5.1.The values were within the range of result. The tomato powder was of limited solubility in water due to low sugar content and it was rich in lipo-soluble substance such as carotenoids. This property has been inversely correlated with the moisture content, as lower moisture content favors a fast solubilization. This property was also related to the effects of the drying conditions on the degradation of the nutritive value due to the time of exposure to high temperatures. Smaller particles produced by the high-speed atomization tend to reach the higher temperatures at the surface and more sensitive to thermal damage and the loss of solubility. (Table:1)

3.1.2 Ash Content

The use of pretreatment (Blanching) and drying increased significantly the ash content of tomato powder compared to the fresh tomato. The sample fresh tomato has the highest ash content of 7.3% while sample SPP has the least value of 2.95 % it also shows that the sample dried by spray drying have lower ash content as compared to the those of dried in SDP, ODP and VDP. This is an indication that drying at a higher temperature decreases the ash content of tomato. It was clear that the ash values decreased gradually with dehydration method.

3.1.3 Protein Content

The protein content of 1.60%, 1.62%, 1.58%, 1.52 % and 1.72% respectively of the variety shows alankar. The results for protein shows that protein content is similar in all the drying techniques showing not much variation in its content and remains to be unaffected by the treatment provided.

3.1.4 Crude Fat Content

In all drying methods, crude fat content of tomatoes was increased as a result of drying powder. The highest crude fat content was found in SDP, ODP, VDP and SPP respectively. When we compare ODP and VDP techniques it was seen that the crude fat content is slightly higher than ODP. Among drying spray dried tomato powder showed highest crude fat content of 2.25, lowest fat content was observed in case of fresh tomato sample this variation in crude fat was dependent upon the variation of moisture content in the samples.

3.1.5 Crude Fiber Content

The Crude Fiber content in the samples of 2.10, 1.68, 1.83, 1.71 and 1.92 % the drying methods used decreased significantly the crude fiber content of tomato powder compared to the fresh tomatoes. The crude fiber content of samples the oven dried was significantly lower than that of samples which are values of SDT respectively. There were no significant differences in crude fiber of tomato powder either SDP or SPP respectively. This is an indication that use of drying techniques does not have many significant eff ects on the crude fiber content of dried tomato powder but the drying method will affect the crude fiber content significantly.

3.1.6 Carbohydrate Content

The carbohydrates content of 4.11%, 3.64%, 4.52%, 4.01 % and 4.70% respectively of the variety shows alankar. The results for carbohydrates shows that carbohydrates content was lower in the hot air oven dried samples, other valves were similar in all the drying techniques showing not much variation in its content and remains to be unaffected by treatment provided. Slight changes in samples could be due to non- enzymatic browning reactions.

3.1.7 p^H Content

The drying techniques increased significantly the pH values of tomato powder compared to the fresh tomatoes. The result shows that the SPP sample raise the pH value of tomato powder sample. ODP sample also increased pH value of the tomato powder. The maximum pH value of 4.90 recorded in the sample dried with SPD. However, the least pH value of 2.95 was observed in SDT sample. This is an indication that the tomato powdered sample dried in SDT caused reduction in sample acidity.

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Table 1 Physico-chemical properties of fresh tomato and dehydrated tomato powder

Drying methods	Moisture (%)	Ash (%)	Crude Protein (%)	Crude Fat (%)	Crude Fiber (%)	pH
FTS	92.5±0.35	7.30±0.40	1.6±0.03	0.48±0.05	2.10±0.10	3.25±0.30
SDP	10.9±0.15	3.25±0.35	1.58±0.03	2.10±0.30	1.83±0.02	2.95±0.50
ODP	7.50±0.33	4.10±0.11	1.62±0.03	1.75±0.25	1.68±0.08	4.00±0.50
VDP	6.11±0.30	3.95±0.37	1.52±0.03	1.85±0.11	1.71±0.03	3.12±0.35
SPP	5.11±0.01	2.95±0.08	1.72±0.04	2.25±0.35	1.92±0.05	4.90±0.45

Each value represent mean of three determinations. Composition was given as on dry weight basis per 100g of edible portion

FTS=Fresh tomato sample; **SDP**=Sun dried powder; **ODP**=Oven dried powder; **VDP**=Vacuum dried powder; **SPP**=Spray dried powder

Fig.2. Effect of drying On Moisture Content. FTS-Fresh Tomato sample; ODP- Oven dried powder; VDP-Vacuum dried powder; SDP-Sun dried powder; SPP –Spray dried powder

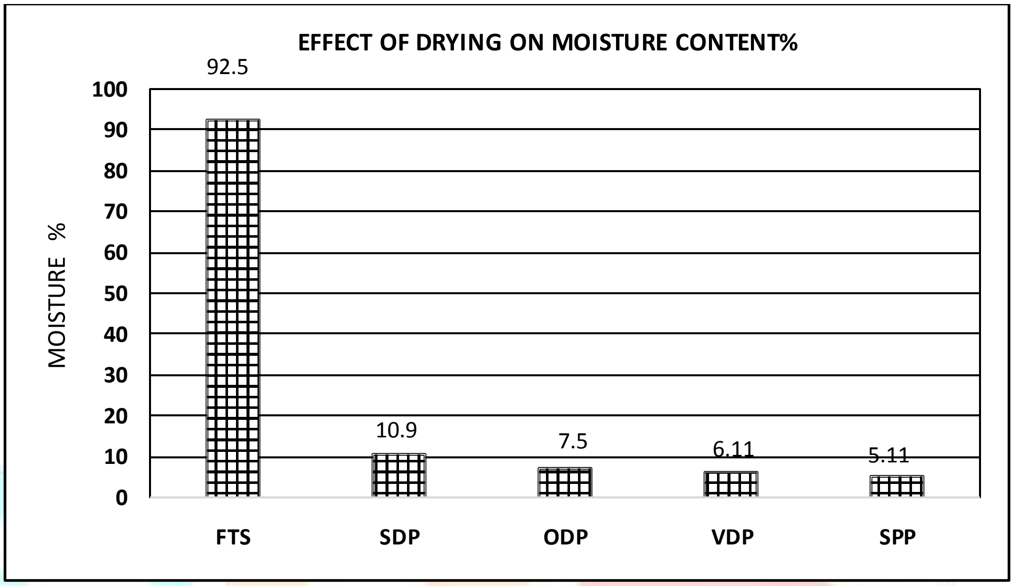


Fig.3. Effect of drying on Ash Content. FTS-Fresh Tomato sample; ODP- Oven dried powder; VDP-Vacuum dried powder; SDP-Sun dried powder; SPP –Spray dried powder

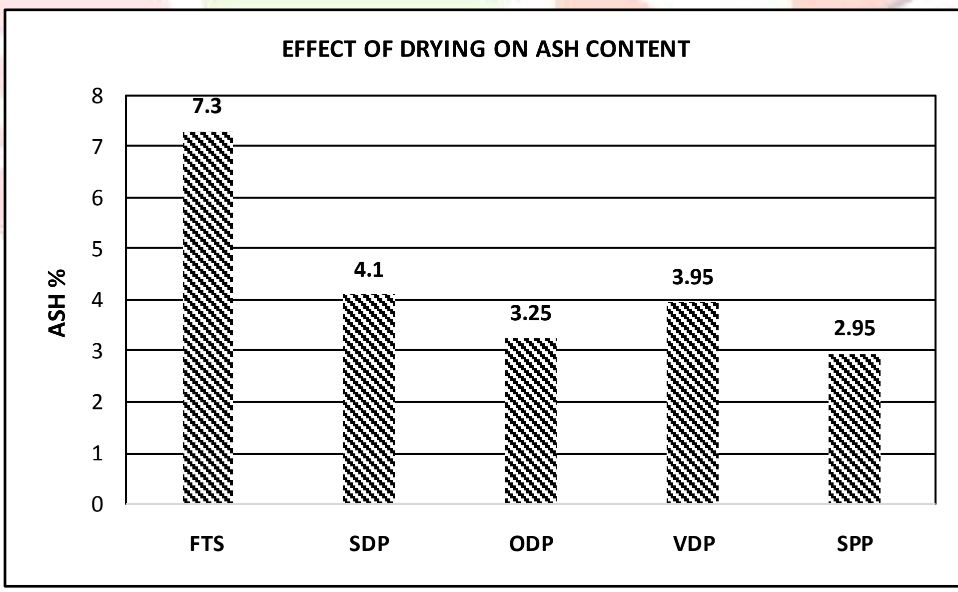


Fig.4. Effect of drying on protein Content. FTS-Fresh Tomato sample; ODP- Oven dried powder; VDP-Vacuum dried powder; SDP-Sun dried powder; SPP –Spray dried powder

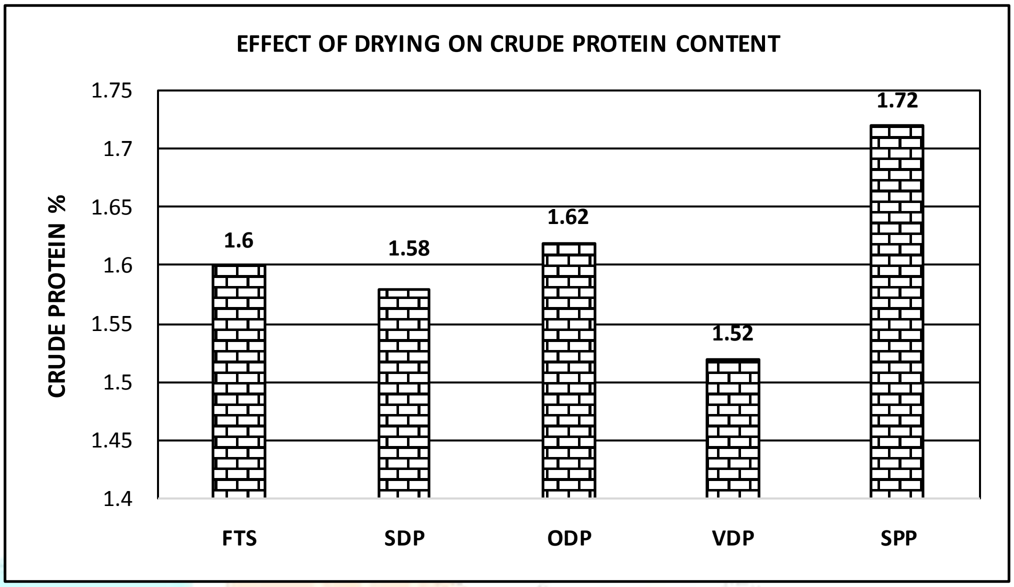


Fig.5.: Effect of drying on Crude Fat content. FTS-Fresh Tomato sample; ODP- Oven dried powder; VDP-Vacuum dried powder; SDP-Sun dried powder; SPP –Spray dried powder

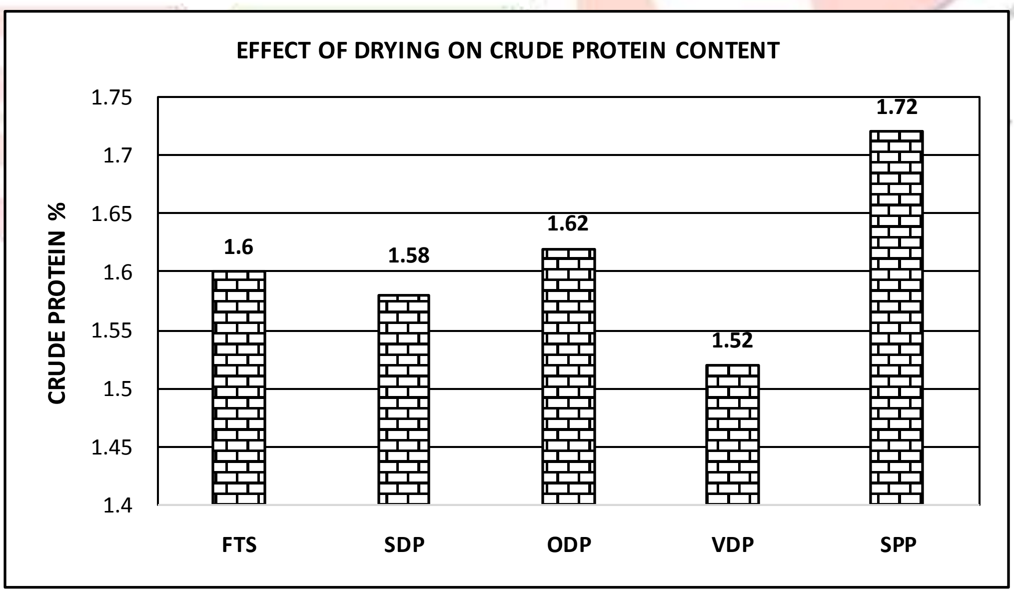


Fig.6. Effect of drying on Crude Fiber content. FTS-Fresh Tomato sample; ODP- Oven dried powder; VDP-Vacuum dried powder; SDP-Sun dried powder; SPP –Spray dried powder

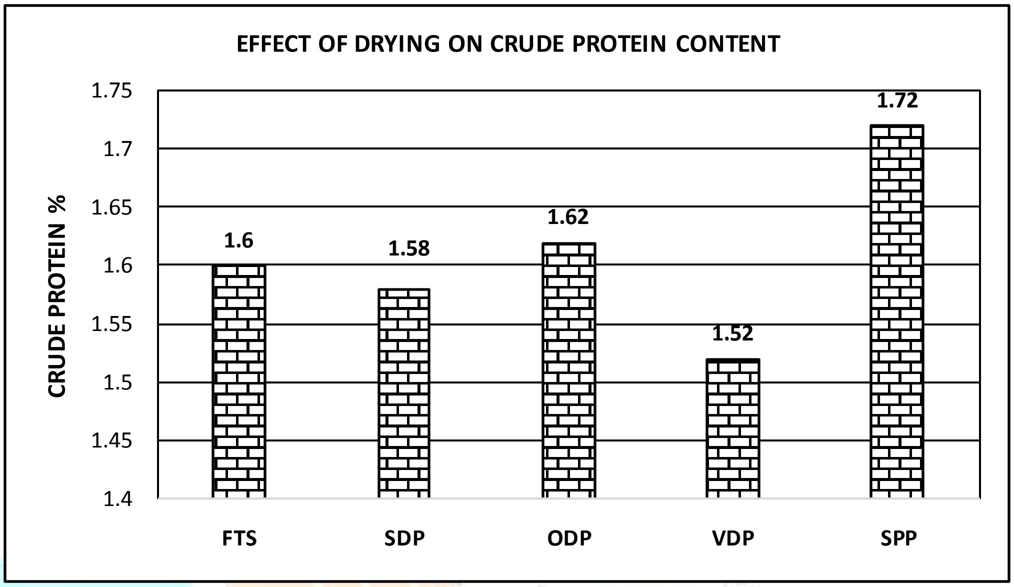


Fig.7. Effect of drying on CHO content. FTS-Fresh Tomato sample; ODP- Oven dried powder; VDP-Vacuum dried powder; SDP-Sun dried powder; SPP – Spray dried powder

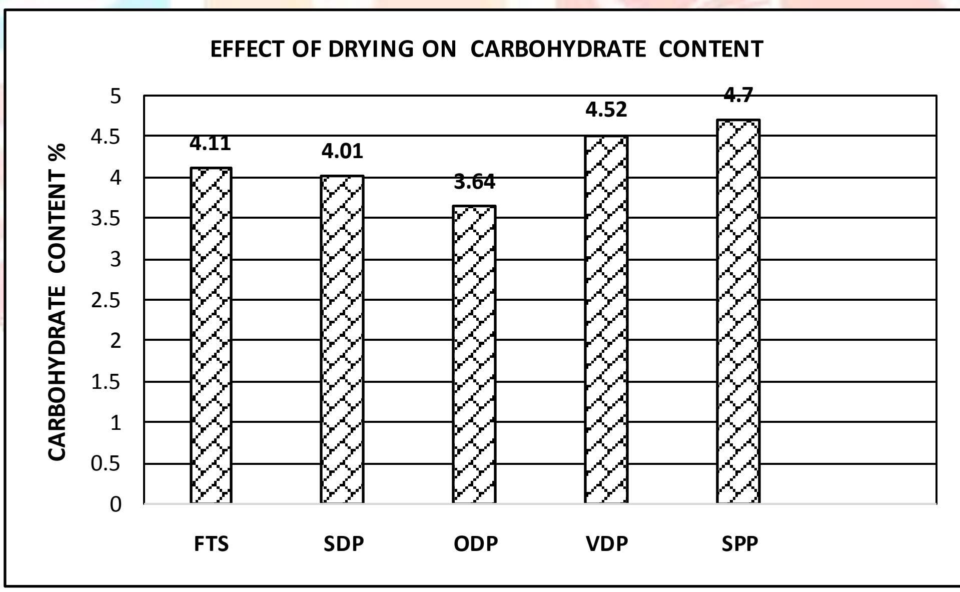
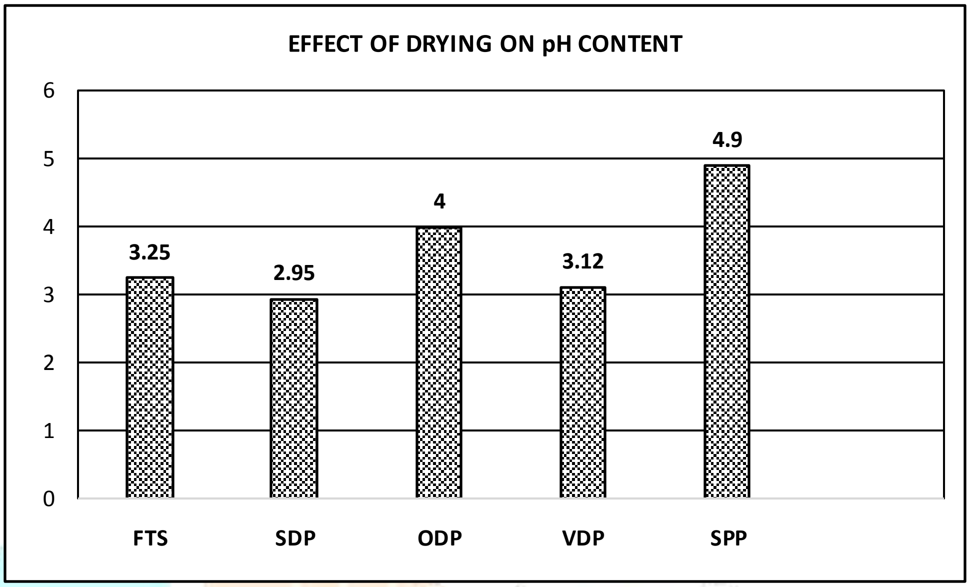


Fig.8 Effect of drying on pH. FTS-Fresh Tomato sample; ODP- Oven dried tomato powder; VDP-Vacuum dried tomato powder; SDP-Sun dried tomato powder; SPP –Spray dried tomato powder



CONCLUSION

From these result, it was concluded that more succeeds results can be obtained using spray type of driers that can remove moisture rapidly from drying chambers, as it is beneficial that these dryers combined with stronger vacuum and less exposures time of heat can be more effective in dried powder technology to keep nutrients in addition to colour. It was found that drying of tomato in v acuum dryer namely oxygen free medium gave some advantages with respect to some nutritional contents on the other hand rather long drying period in vacuum drying method. in order to obtain products with better sensory and nutritional characteristics and be tter process yield.

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