JOURNAL OF PURE AND APPLIED MICROBIOLOGY, Dec. 2016. Vol. **10**(4), p. 2997-3002

Effect of Microbial Growth on Dehydrated Tomato Powder During different Drying Conditions

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http://dx.doi.org/10.22207/JPAM.10.4.69

(Received: 17 April 2016; accepted: 20 June 2016)

The effect of green house type solar dryer and cabinet type dryer used for tomato drying with pretreatment of preservatives. We can see that the microbial growth not detected in the starting 30 days but the highest microbial count is 4.67×10^5 of untreated samples (6mm) in aluminum foil package under green house type solar dryer and microbial growth 4.55×10^5 of untreated samples (6mm) in LDPE packaging under cabinet tray dryer (65 °C). These are samples packed in LDPE and aluminum foil packaging materials and stored at room temperature. All microorganisms have a defined temperature range in which they grow, with a minimum, maximum, and optimum. An understanding of the interplay between time, temperature, and other intrinsic and extrinsic factors is crucial to selecting the proper storage conditions for a food product.

Keywords: Green house type solar dryer, cabinet tray dryer, LDPE, Aluminium foil pouch, tomato and temperature, thickness.

Tomato (*Lycopersicon esculentum*) belongs to the genus *Lycopersicon* under *Solanaceae* family. Tomato is an herbaceous sprawling plant growing to 1-3 m in height with weak woody stem. The flowers are yellow in color and the fruits of cultivated varieties vary in size from cherry tomatoes, about 1–2 cm in size to beefsteak tomatoes, about 10 cm or more in diameter. Most cultivars produce red fruits when ripe. Tomato is a native to Peruvian and Mexican region. Though there are no definite records of when and how it came to India, the Portuguese perhaps introduced it to India.

Tomato is the world's largest vegetable crop and known as protective food both because of its special nutritive value and also because of its wide spread production. Tomato is one of the most important vegetable crops cultivated for its fleshy fruits. Tomato is considered as important commercial and dietary vegetable crop. Botanical name of tomato is *Lycopersicon esculemtun* and belongs to family *Lycopersicae*. Tomato is protective supplementary food. As it is short duration crop and gives high yield, it is important from economic point of view and hence area under its cultivation is increasing day by day. Tomato is used in preserved products like ketch-up, sauce, chutney, soup, paste, puree etc.

Tomatoes are climacteric in nature[1]. Climacteric fruits submitted to gamma irradiation exhibit a delay of ripening [2-4]. In the specific case of tomatoes, irradiation generally delays ripening when the treatment is applied at the pre-climacteric stage [5-6,4].

It can be grown in most places all over the world, like growing in the field, greenhouses and net houses. The tomato crop is grown and used for both fresh market and processing and it is

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an adaptable crop. Over the past 25 years, the demand on tomato recorded highly data in both producing and consuming and it has grown quite rapidly. Nowadays, tomato occupied an area about 3.9 million hectares all over the world for growing, and annually about 108 million metric tonnes of tomato will be produce for both fresh market and processing. Tomato has valuable vitamins for instance vitamin A and C and also it contains fibers, and is known as free in having cholesterol. Generally, the average size of tomato equal to (148g) boasts only 35 calories. Approximately 20–50 mg of lycopene/100g of fruit weight can be found in tomato. Lycopene is a member of the family of pigments, which called as carotenoids. This family has the ability to form colors in fruits and vegetables, naturally. Lycopene is the best powerful antioxidant in the carotenoid family and it prevents humans from free radicals that degrade many parts of the body, lycopene is also known to protect human from cancer. Several studies have indicated that lycopene levels remain relatively stable during thermal processing[7-10].

Studies concerning the effects of drying on tomato antioxidant components has demonstrated that the lycopene in tomatoes is substantially stable during industrial drying [11].

Microbiology is a specialized area of biology dealing with organisms too small to be seen without sufficient magnification. Microbiologists study bacteria, fungi, parasites, viruses, and prions and their interactions with humans, animals, plants, and the environment. While viruses and prions are not living organisms like bacteria, fungi, and parasites, they are studied by microbiologists; therefore, we will use the term microbe to collectively refer to any of these biologically active and microscopic entities. Food microbiology is specifically concerned with the desirable and undesirable effects microbes can have on the quality and safety of food products. In this section, we will briefly survey the importance of microbes in food. We will overview some fundamental microbiological concepts and consider how microbes are involved in food spoilage, food preservation, and food borne illness.

Our discussion of microbial growth will focus primarily on bacterial growth. Similar concepts apply to the growth of molds, yeasts, and some protozoa. Many parasites have complex life cycles, a discussion of which is beyond the scope of our purposes here. The most important parasites (e.g., Trichinella spiralis in pork) cannot reproduce in meat or poultry products. Replication of prions and viruses will also not be discussed, because these microbes can only be replicated in the live animal. If favorable environmental conditions exist, bacterial growth occurs. For our purposes, we will use the term growth to refer to an increase in microbe numbers, not an increase in size of an organism. Bacteria reproduce by dividing, a process called binary fission. When a bacterial cell is ready to divide, the material within it gradually increases until the cell's volume is almost doubled. The cocci shapes become oval while rod shapes stretch to nearly twice their length. The cell then constricts in the middle.

MATERIALS AND METHODS

Samples preparation

Fresh tomato was purchased from the local market of Meerut. The tomato then thoroughly cleaned to remove any dust particles attached to the surface. Then the sorted cleaned tomato was cut into the uniform thickness of 4.0mm, 6.0mm and 8.0mm. For the treated samples after cutting in to different sizes and slices were dipped into a solution (ml) 1:4 ratio of second class preservative (sodium benzoate and potassium metabisulphite). After that different type of drying methods (cabinet tray dryer, foam mat drying and solar dryer) were used for drying and samples were stored at room temperature.

Cabinet tray dryer method

The pre-treated and untreated tomato slices were dried in the cabinet tray dryer. A cabinet dryer was used for the dehydrated tomato experiments. The tomatoes slices were placed uniformly on stainless steel trays (80 cm length × 40 cm width and 1.37 kg weight) and experiments were conducted at 65 ^{0}C temperature. Weight losses (moisture content) of sample during drying process was determined, after each 1 hour interval and continued until no further weight changes were observed. After cooling at room temperature, the dried tomato flakes were crush by using blender to produce tomato powder. The tomato powder was packaged by LDPE and aluminum foil for further investigation or analytical research.

Green house type solar dryer method

The pre-treated and untreated tomato slices were dried in the solar dryer (length 5.0 m × width 3.0 m and height 2.3 m, dryer frame 38 mm square MS pipe, 75 % transparency 200ì UV stabilized LDPE poly film). The tomatoes slices were placed uniformly on drying trays (35 cm length × 30 cm width × 5.0 cm height size wooden framed with perforated stainless steel base). Weight losses (moisture content) of sample during drying process was determined, after each 1 hour interval and continued until no further weight changes were observed then after cooling at room temperature, the dried tomato flakes were grind by using blender to produce tomato powder. The tomato powder was packaged LDPE and aluminum foil pouch for further investigation or analytical research.

RESULTS AND DISCUSSIONS

Effect of microbial growth of tomato powder during storage

The microbial loads of the tomato powder during storage are shown in table 1.1 to 1.4. The highest microbial growth 4.55×10^5 of untreated samples (6mm) in LDPE packaging and 4.49×10^5 of untreated samples (8mm) in aluminum foil package after 120 days under cabinet tray dryer (65 ^{0}C). The green house type solar dyer is second drying methods, in this dryer highest microbial growth 4.56×10^5 of untreated samples (8mm) in LDPE packaging, 4.67×10^5 of untreated samples (6mm) in aluminum foil package after 120 days under green house type solar dryer but we can see number of microbial growth not detected in the starting of 30 days. All means scores, bearing different superscripts in columns differ significantly ($p<0.05$). microorganisms have a defined temperature range in which they grow, with a minimum, maximum, and optimum. An understanding of the interplay between time, temperature, and other intrinsic and extrinsic factors is crucial to selecting the proper storage conditions for a food product. We are used two types of packaging materials because the low density polyethylene (LDPE) has good tensile strength, burst strength, impact resistance and tear strength retaining its strength down to – 60 ^{0}C. It is an excellent barrier to water and water vapour. Aluminum foil is the second most popular type of aluminum packaging. Its insulating properties make it a leader among other solid and flexible materials. A thin layer of aluminum foil, which is sometimes only 6.35 microns thick (its thickness

Table 1. Change in microbial growth of the samples of dehydrated tomato powder under cabinet tray dryer and store in LDPE pouch

	LDPE Packaging Cabinet Tray Dryer								
Storage	Untreated			Treated (KMS)			Treated (Sodium Benzoate)		
Periods	4mm	6mm	8mm	4mm	6mm	8mm	4mm	6mm	8mm
0	ND	ND	ND	ND	ND	ND	ND	ND	ND
30	ND	ND	ND	ND	ND	ND	ND	ND	ND
60	2.26×10^5	2.38×10^5	2.50×10^5	1.78×10^5	1.82×10^5	1.85×10^5	1.80×10^5	1.82×10^5	1.90×10^5
90	3.55×10^5	3.68×10^5	3.72×10^5	2.12×10^5	2.35×10^5	2.30×10^5	2.29×10^5	2.66×10^5	2.70×10^5
120	4.00×10^5	4.55×10^5	4.50×10^5	3.45×10^5	3.39×10^5	3.30×10^5	3.49×10^5	3.67×10^5	3.65×10^5

ANOVA for the change in microbial growths

Source	D.F.	S.S	M.S.	F-Cal	Significance
Replications	02	0.20			
Treatment	08	19.46	2.43	192.04	0.000000
Error	16	0.20	0.01		
Total	26	19.86			

CD	0.196
SE (d)	0.092
SE (m)	0.065
CV	3.922

: - ND= Not Detected

is eight times less than a bank note), provides full protection from light and liquid.

Polymers such as low-density polyethylene (LDPE) constitute a majority of primary packages for foods and beverages and a great deal of research has been devoted to the development of active polymer packaging[12]. Many food products can be subjected to contamination by undesirable microbes such as fungi, yeast and bacteria[13].

Table 2. Change in microbial growth of the samples of dehydrated tomato powder under cabinet tray dryer and store in aluminum foil pouch

Aluminium Foil Packaging Cabinet Tray Dryer									
Storage	Untreated			Treated (KMS)			Treated (Sodium Benzoate)		
Periods	4mm	6mm	8mm	4mm	6mm	8mm	4mm	6mm	8mm
0	ND	ND	ND	ND	ND	ND	ND	ND	ND
30	ND	ND	ND	ND	ND	ND	ND	ND	ND
60	2.36×10^5	2.40×10^5	2.52×10^5	1.88×10^5	1.98×10^5	1.80×10^5	1.80×10^5	1.86×10^5	1.91×10^5
90	3.70×10^5	3.60×10^5	3.66×10^5	2.42×10^5	2.59×10^5	2.52×10^5	2.49×10^5	2.57×10^5	2.76×10^5
120	4.12×10^5	4.35×10^5	4.49×10^5	3.59×10^5	3.72×10^5	3.80×10^5	3.69×10^5	3.71×10^5	3.79×10^5

ANOVA for the change in microbial growths

Source	D.F.	S.S	M.S.	F-Cal	Significance
Replications	02	0.08			
Treatment	08	19.37	2.42	349.17	0.000000
Error	16	0.11	0.01		
Total	26	19.56			

CD	0.145
SE (d)	0.068
SE (m)	0.048
CV	2.808

ND= Not Detected

Table 3. Change in microbial growth of the samples of dehydrated tomato powder under green house type solar dryer and store in LDPE pouch

LDPE Packaging Green House Type Solar Dryer									
Storage	Untreated			Treated (KMS)			Treated (Sodium Benzoate)		
Periods	4mm	6mm	8mm	4mm	6mm	8mm	4mm	6mm	8mm
0	ND	ND	ND	ND	ND	ND	ND	ND	ND
30	ND	ND	ND	ND	ND	ND	ND	ND	ND
60	2.55×10^5	2.50×10^5	2.62×10^5	1.92×10^5	1.99×10^5	1.82×10^5	1.85×10^5	1.86×10^5	1.95×10^5
90	3.88×10^5	3.75×10^5	3.81×10^5	2.39×10^5	2.44×10^5	2.72×10^5	2.57×10^5	2.59×10^5	2.81×10^5
120	4.26×10^5	4.49×10^5	4.56×10^5	3.64×10^5	3.78×10^5	3.89×10^5	3.79×10^5	3.78×10^5	3.96×10^5

ANOVA for the change in microbial growths

Source	D.F.	S.S	M.S.	F-Cal	Significance
Replications	02	0.10			
Treatment	08	20.97	2.62	307.26	0.000000
Error	16	0.14	0.01		
Total	26	21.20			

CD	0.145
SE (d)	0.068
SE (m)	0.048
CV	2.808

ND= Not Detected

Aluminum foil is easily sterilized so it is not surprising that it is widely used by producers of medicines and cosmetic and hygiene articles. It is also commonly used for pill blister-packs. Temperature has dramatic impact on both the generation time of an organism and its lag period. Over a defined temperature range, the growth rate of an organism is classically defined as an Arrhenius relationship[14].

Table 4. Change in microbial growth of the samples of dehydrated tomato powder under green house type solar dryer and store in LDPE pouch

Storage	Aluminum Foil Packing Green House Type Solar Dryer								
	Untreated			Treated (KMS)			Treated (Sodium Benzoate)		
Periods	4mm	6mm	8mm	4mm	6mm	8mm	4mm	6mm	8mm
0	ND	ND	ND	ND	ND	ND	ND	ND	ND
30	ND	ND	ND	ND	ND	ND	ND	ND	ND
60	2.50×10^5	2.53×10^5	2.65×10^5	1.96×10^5	1.90×10^5	1.80×10^5	1.81×10^5	1.83×10^5	1.92×10^5
90	3.89×10^5	3.79×10^5	3.88×10^5	2.47×10^5	2.67×10^5	2.88×10^5	2.68×10^5	2.79×10^5	2.77×10^5
120	4.38×10^5	4.67×10^5	4.52×10^5	3.79×10^5	3.63×10^5	3.86×10^5	3.88×10^5	3.91×10^5	3.83×10^5

ANOVA for the change in microbial growths

Source	D.F.	S.S	M.S.	F-Cal	Significance
Replications	02	0.03			
Treatment	08	21.75	2.72	253.75	0.000000
Error	16	0.17	0.01		
Total	26	21.95			

CD	0.181
SE (d)	0.085
SE (m)	0.060
CV	3.359

ND= Not Detected

CONCLUSION

Food producers or manufacturers address the concept of time as it relates to microbial growth when a product's shelf life is determined. All microorganisms have a defined temperature range in which they grow, with a minimum, maximum, and optimum. Over a defined temperature range, the growth rate of an organism is classically defined as an Arrhenius relationship. We are found best sample treated with KMS under aluminum foil package at tray dryer and green house type solar dryer. Increasing microbial bacteria in foam mat drying samples because egg albumen a bacterial source growth with presence in moisture, temperature and storage conditions.

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