

## Physico-chemical and quality evaluation of tomato ketchup during storage

\*Vishal Kumar<sup>1</sup>, Lalit Kumar<sup>1</sup>, Kapil Kumar<sup>1</sup>, S. K. Goyal<sup>2</sup>, Amit Kumar<sup>3</sup>  
and Garima Jain<sup>4</sup>

<sup>1</sup>Deptt. of Agric. Engg. and Food Technology, SVPUAT, Meerut (U.P.)

<sup>2</sup>KVK, Institute of Agric. Sciences, BHU, RGSC, Barkachha, Mirzapur (UP)

<sup>3</sup>Department of Food Science and Technology, Shri Venkateshwara University, Gajraula

<sup>4</sup>Bhikaji Cama Subharti Institute of Hotel Management, SVS University, Meerut

\*Email: vishalkumarsingh129@gmail.com

### Abstract

A comparative study was done to determine the most suitable storage conditions. The selected quality and parameters of tomato ketchup were determined, the tomato slices were treated with KMS, sodium benzoate and control and dehydrated in cabinet tray dryer at 65 °C for preparation of ketchup. The ketchup stored in the refrigerator (5°C) samples was found superior as compared to the room temperature storage. A gradual increase in Total Soluble Solids (TSS) and pH was observed during storage whereas acidity and ascorbic acid were decreased.

**Keyword:** Dehydrated tomato, ketchup, cabinet tray dryer, KMS and Sodium benzoate.

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### Introduction

Tomatoes (*Lycopersicon esculentum* L. var) are the world's most commercially produced and used vegetable crop (Ensminger *et al.*, 1994). The annual Indian production of tomatoes has been estimated at 7.277 million tonnes in an area of about 0.458 million hectares. It is very important in the economic point of view and hence the global production of tomatoes (fresh and processed) has been increased by 300 % in the last four decades (FAO, 2005) and the leading tomato producers are in both tropical and temperate regions (Dhaliwal *et al.*, 2003).

Worldwide, tomatoes are considered an important agricultural crop and an integral part of the human diet. Although tomatoes are commonly consumed fresh, over 80% of the tomato consumption comes from processed products such as tomato juice, ketchup and sauce. Recent studies have indicated the potential health benefits of a diet that is rich in tomatoes. Lycopene, a major carotenoid

without provitamin activity, present in red tomatoes, is considered responsible for their beneficial effects (Shi *et al.*, 1999; Rao *et al.*, 1998). Comparing with other natural antioxidants in plant tissues, carotenoids are relatively heat stable even after intense or prolonged heat treatment such as sterilization processes or cooking (Nicoliet *et al.*, 1999). However, during the processing and subsequent storage of products the content of carotenoids falls down and the color changes. The overheated or expired products have typical brown color and various off-flavors and oxidized flavor caused by low molecular compounds produced by oxidation of carotenoids and other lipids. The degradation reaction within the processing starts with cis-trans isomerisation, fresh tomatoes contain all-trans lycopene, the processed tomato products contain between 1.7% and 10.1% cis-isomers (Shi and Mageur, 2000).

According to King and Zeidler (2004), tomato pomace contains 5.1% moisture, 11.9% fat, 26.8% protein and 26.3% crude fiber. Moreover, it contains 13% more lysine

than soybean protein (AL-Betawi, 2005), a good source of vitamin B, fair source of vitamin A and no known anti-nutritive factors (Geisman, 1981). During the drying process and storage periods conditions, oxidative damage takes place in tomato (Zanoniet *al.*, 1999; Toor and Savage, 2006; Sharma and Maguer, 1996; Zanoniet *al.*, 2000). (Shi and Maguer, 2000), indicated that the main causes of lycopene degradation during processing and storage are isomerisation and oxidation.

Lycopene is also a potent neuroprotective (Hisaoet *al.*, 2004), antiproliferative, anticancer (Gunasekeraet *al.*, 2007), anti-inflammatory, cognition enhancer (Akboralyet *al.*, 2007) and hypocholesterolemic agent (Risoet *al.*, 2006). Lycopene has been under considerable investigation for its antioxidant benefits in treating various chronic human diseases like cancer, cardiovascular diseases, osteoporosis and diabetes (Rao and Rao 1998). Ketchup is the product that is generally made from tomato paste after diluting on 15% of the soluble solids. It is flavored with sugar, salt, vinegar, spices, red pepper extract or other ingredients, such as onion, garlic, extracts of spiced herbs and the like (Drdák 1989, Intelmannet *al.*, 2005). Commercial ketchup can have an extremely variable composition; nearly all manufacturers have a formula of their own which differs in some respects from those of other manufacturers.

## Materials and Methods

### Samples preparation

Fresh tomato was purchased from the local market Meerut. The tomato then thoroughly cleaned and to remove any dust particles attached to the surface. After slices the tomato were dipped into a solution (ml) 1:4 ratio of second class preservative (sodium benzoate and potassium metabisulphite). The slices were then taken out from the solution and the surface moisture was wiped by blotting paper. The treated tomato sliced was dried by cabinet dryer and obtained dried slices followed to prepare the tomato powder than tomato ketchup.

### Drying of sample

The pre-treated (KMS & sodium benzoate) and untreated tomato slices were dried in the cabinet tray dryer. The tomatoes slices were placed uniformly on stainless steel trays (80 cm length × 40 cm width and 1.37 kg weight) and drying were conducted at 65 °C temperature. The dried tomato flakes cooled at room temperature, then crushed by using blender to produce tomato powder for preparation of tomato ketchup. The tomato ketchup was stored for further investigation or analytical research. The process flow chart of preparation of tomato ketchup is given in Fig.1.

### Evaluation of physico-chemical properties

**Total Soluble Solids (TSS):** TSS of tomato ketchup was measured by hand refractometer of range of 0-32°Brix recommended by Ranganna (2001).

**pH:** pH is the measurement of the logarithm of inverse of hydrogen ion concentration in the solution or pH is the measurement of H<sup>+</sup> activity. The pH values were determined using the digital pH meter, as described by Ranganna (2001).

**Acidity:** Acidity may be referred as the percent total acid in any food substance. The organic acid is responsible for the sourness of fruit. Acidities of final products were determined using the method as recommended by Ranganna (2001).

**Ascorbic acid:** Ascorbic acid in ketchup is determined by titration recommended by Ranganna (2001).

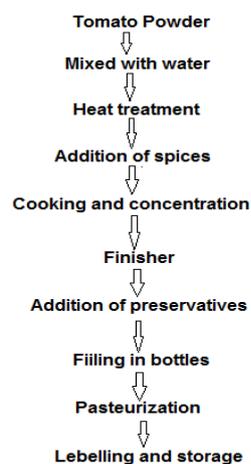


Fig. 1: Process flow chart of tomato ketchup preparation

## Results and Discussion

**Effect on Acidity:** The effect of storage on acidity of dehydrated tomatoes powder based ketchup is presented in Table 1. The acidity of tomato ketchup samples treated before drying of tomato slices with potassium metabisulphite (KMS) and sodium benzoate (SB) in cabinet tray dryer at 65°C. During refrigeration and room temperature storage conditions, it was observed that acidity of all the samples was decreased with increasing the storage periods. The lowest acidity of tomato ketchup during room temperature storage was found 1.51% (UT), 1.54% (KMS) and 1.53% (SB) at room temperature while 1.55% (UT), 1.60% (KMS) and 1.54% (SB) during refrigeration after 120 days. The acidity significantly decreased with increased storage period. The study revealed that the ketchup made from untreated tomato powder showed highest (1.75%) acidity just after preparation and lowest 1.51% as well as 1.54% storage of 120 days at room temperature and refrigerator (5°C). From Table 1 showed that lowest temperature of storage or refrigeration increased that acidity as compared to room temperature. Similar results found by Kumar *et al.*, (2015). In freshly ketchup, untreated sample had higher acidity followed by sodium benzoate and KMS while after 120 days storage acidity observed as KMS>SB>UT at room temperature and KMS>UT>SB in refrigeration at 5°C.

**Effect on pH:** During refrigerator and room temperature storage conditions, it was observed, that acidity of all the samples was increased at 0, 30, 60, 90 and 120 days of storage conditions (Table 1). Among the parameters analyzed for the assessment of tomato quality, pH is very important because acidity influences the thermal processing conditions required for producing safe products. The highest pH found 4.6 (KMS) followed by 4.5 (UT), and 4.4 (SB) at room temperature after 120 days of storage whereas 4.6 (SB) followed by 4.5 (UT), 4.4 (KMS) at refrigerator temperature after 120 days. The pH value increase with the effect of sugar concentration dilute in tomato ketchup

samples and secondly effect of storage condition during room temperature and refrigerator conditions. Change in pH is directly related to change in acidity of samples. Similar findings were reported by Ahmad (1997) during his study on tomato concentrate. The acidic pH values obtained in this study is characteristic of most fruits and this influences the shelf life quality by restricting the micro flora to acid – tolerant microorganisms (Bracket, 1994).

**Effect on TSS:** TSS for fresh sample was found highest in SB (27.4) followed by KMS (25.7) and 23.0 in UT under room and refrigeration storage. The highest value was found 40.7 in the sample dried by cabinet tray dryer treated with sodium benzoate at room temperature. The TSS values were observed highest 40.7 for (SB), 33.4 (UT) and 32.0 (KMS) at room temperature while 36.4 (KMS), 34.7 (UT) and 34.0 (SB) in refrigeration after 120 days of storage (Table 1). There was increased in TSS with increase in storage temperature. The TSS values were affected by the drying process. The increase value of TSS in the ketchup sample with effect of the sugar concentration include in the tomato ketchup sample. Actually the TSS value increased during storage condition. Increase in T.S.S. during storage may be due to acid hydrolysis of polysaccharides especially gums and pectin (Luh and Woodroof, 1975). The treatment of tomato before drying is also affect the TSS of ketchup if made from tomato powder. Sodium benzoate (SB) represented higher TSS followed by UT and KMS at room temperature whereas KMS>UT>SB showed TSS in refrigeration after storage of 120 days.

**Effect on Ascorbic Acid (Vitamin-C):** The effect of storage on ascorbic acid of dehydrated tomato powder based ketchup is presented in Table 1. The ascorbic acid of tomato ketchup samples treated before drying of tomato slices with potassium metabisulphite (KMS) and sodium benzoate (SB) in cabinet tray dryer at 65 °C. During refrigeration and room temperature storage conditions, it was observed that ascorbic acid of all the samples

was decreased with increasing the storage periods. The lowest ascorbic acid of tomato ketchup during room temperature storage was found 12 (UT), 14 (KMS) and 14 (SB) at room temperature while 14 (UT), 13 (KMS) and 14 (SB) during refrigeration after 120 days. The ascorbic acid significantly decreased with increased storage period. The study revealed that the ketchup made from untreated tomato powder showed highest (38) ascorbic acid just after preparation and lowest (12) storage of 120 days at room temperature and refrigeration

(5 °C). From the table 1 showed that lowest temperature of storage or refrigeration increased that ascorbic acid as compared to room temperature. The temperature influences the decreased in ascorbic acid. Similarly findings were reported by (smith and Hui, 2004) ascorbic acid may be destroyed by oxidation, especially at higher temperature. Its stability is greatly influenced by temperature, oxygen and metal ion content. Vitamin-C is the most labile of the nutrients, so its degradation is used as an indicator of quality.

**Table 1: Effect of acidity, pH and TSS of the tomato ketchup samples during storage conditions**

<i>Room Temperature</i>									
Storage Periods(days)	Acidity (%)			pH			TSS ( <sup>0</sup> Brix)		
	UT	KMS	S. B.	UT	KMS	S. B.	UT	KMS	S. B.
0	1.75	1.72	1.74	3.5	3.8	3.6	23.0	25.7	27.4
30	1.70	1.69	1.71	3.9	4.0	3.8	25.0	27.4	29.3
60	1.67	1.63	1.64	4.2	4.2	4.1	28.1	29.6	31.2
90	1.60	1.58	1.55	4.4	4.5	4.3	30.5	31.2	33.4
120	1.51	1.54	1.53	4.5	4.6	4.4	33.4	32.0	40.7
<i>Refrigerator (5<sup>0</sup>C)</i>									
Storage Periods(days)	Acidity (%)			pH			TSS ( <sup>0</sup> Brix)		
	UT	KMS	S. B.	UT	KMS	S. B.	UT	KMS	S. B.
0	1.75	1.72	1.74	3.5	3.8	3.6	23.0	25.7	27.4
30	1.72	1.70	1.70	3.8	3.9	3.8	27.5	29.7	32.5
60	1.69	1.67	1.65	4.0	4.0	4.2	30.6	31.4	35.9
90	1.60	1.64	1.58	4.3	4.2	4.5	32.4	33.8	37.4
120	1.55	1.60	1.54	4.5	4.4	4.6	34.7	36.4	34.0

**Table 2: Effect of ascorbic acid of the tomato ketchup samples during storage conditions**

Storage Periods (days)	Room Temperature			Refrigerator (5 <sup>0</sup> C)		
	UT	KMS	S. B.	UT	KMS	S. B.
0	32	36	38	32	36	38
30	26	24	24	24	31	30
60	22	20	20	20	27	25
90	17	16	16	16	19	18
120	12	14	14	14	13	14

(UT: Untreated; KMS: Potassium metabisulphite; SB: Sodium benzoate)

The losses of ascorbic acid is probably attributable to oxidation of ascorbic acid to dehydroascorbic acid followed by hydrolysis of the latter to 2,3-diketogluconic acid, which than undergoes polymerization to other nutritionally inactive products (Dewantoet *al.*, 2002).

### Conclusion

It was conclusion of dehydrated tomato powder based ketchup could be stored at room temperature and refrigeration (5<sup>0</sup>C) for 120 days. In this study ketchup produced by tomato powder than after analysis on the basis of physicochemical other properties of these ketchup samples. However, a gradual increase in Total Soluble Solids (TSS) and pH was observed during storage whereas acidity and ascorbic acid were decreased.

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