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Packaging of instant Mix Tomato Khaman Powder using Simple or Vacuum Packaging Laminated Aluminium Foil

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ABSTARCT: Due to over growing population, the world is facing a challenge related to food products. Instant food products have become an essential component in meeting the demands of human consumption. Products made from tomatoes after they have been processed are very significant to improving public health. Mashed/cooked tomatoes provide higher levels of lycopene compared to entire tomatoes. This study aims to conduct in-depth research into the topic of packaging instant mix tomato khaman powder utilising either simple packaging or vacuum packaging laminated aluminium foil. The storage stability of optimised instant mix tomato khaman powder was evaluated at 15-day intervals over a storage period of up to 75 days using laminated aluminium foil pouches (LAFP) and low-density polyethene bags (LDPE) with and without vacuum packaging. The storage period started at 15 days and went up to 75 days. The study found that the sensory score of colour, aroma, taste, and overall acceptability of instant mix tomato khaman powder were highest in LAFP with vacuum packaging as opposed to LAFP without vacuum packaging and polyethene bags with as well as without vacuum packaging throughout the storage period. As a result, the storage of the quick mix tomato khaman powder was best accomplished with the laminated aluminium foil pouch that had vacuum packaging.

Keywords: Tomato Khaman Instant Mix Powder; Storage Stability; Packaging; Aluminium Foil.

INTRODUCTION

The tomato, a well-known vegetable all over the world, is a member of the Solanaceae family. Because of its commercial importance and the fact that it is highly perishable, the tomato (*Solanum lycopersicum*) is a vegetable that has been subjected to the most research in the field of scientific study. It is estimated that post-harvest losses range from 25 to 50 percent in tropical countries between harvesting and consumption. The reason why tomatoes are so easily spoiled is due to the large percentage of water (approximately 95%) they contain (Correia *et al.*, 2015). Tomatoes are an excellent source of minerals and vitamins in addition to being full of the antioxidant lycopene (60-90 mg/kg), vitamin C (160-240 mg/kg), polyphenols (10-50 mg/kg) as well as small quantities of vitamin E (5-20 mg/kg) (Kabore *et al.*, 2022). Lycopene is measured in milligrams per kilogram. The tomato is used in a variety of ways and is consumed at all times of the year. It is incredibly refreshing, and it has a flavour that is quite agreeable to the palate.

Due to their high moisture content, fresh tomato puree, sauce, ketchup, pickles, etc. have a shorter shelf life. Dehydrated tomato powder simplifies transport and storage. Powdering tomatoes reduces waste, price, and availability year-round (Nasir *et al.*, 2015). New recipes can use dehydrated tomato powder. Fresh tomatoes require pricey machinery. So, the competitive market requires low-cost manufacturing and packaging for shelf-stable and convenient items. Drying minimises volume and shipping expenses, resulting in low-cost, high-quality items. Producing more will benefit farmers (Bhatkar *et al.*, 2021; Sudhir & Navneet 2023).

This research aims to explore instant mix tomato khaman powder packaging using either straightforward packaging or vacuum packaging laminated aluminium foil, both of which are elaborated upon in the subsequent sections of this study.

LITERATURE REVIEW

Suhag and Nanda (2016) evaluated honey powder for ascorbic acid, total phenolic content, glass transition temperature, and hygroscopicity for 180 days in aluminium laminated polyethene and high-density polyethene (HDPE) at 25°C (room temperature) and 35°C (accelerated temperature). Public knowledge of ready-to-cook product quality drives shelf-life studies (Srivalli *et al.*, 2017). Tomato powder-incorporated rice-based cold extrudates were tested for shelf life and quality. Stored samples underwent sensory and microbiological testing every 60 days. Room-temperature extrudates last 45 days. Storage lowered lycopene content. All samples exhibited TBC and TMC <2 CFU/ml after 60 days. LDPE samples stored at room temperature for 30 days at 10-1 dilution had no microbiological burden.

Globalization has made instant drinks essential (Minah & Astuti 2018). This statistic lets us study vitamin-packed premium drinks. How to manufacture tasty, low-impact fast drinks is still debated. This vacuum evaporator study varied temperature, time, and filler. The product tests vitamins and antioxidants. Surendar *et al.* (2018) studied tomato drying for tomato powder. Tomato slice drying was studied. Estimating tomato slice dry weight involved drying temperature and duration. Drying affected Proximate Composition, Functional Attributes, and Phytochemicals. The study examined dried tomato powder composition and function. Moisture, fat, ash and Lycopene were discovered.

Manjula *et al.* (2023) describe tomatoes as tropical American solanaceous fruit veggies. Spanish tomato comes from the Nahuatl Tomati, "the expanding fruit." This research creates and evaluates Instant Tomato Powder. Tomatoes were dried under a tray and hot air oven drier at 60°C and blanched for 30 seconds at 90°C. Tray dryers outperformed hot air oven dryers in making tomato powder. Tomato powders were examined for moisture, ash, bulk density, tapered density, flowability, Carr index, swelling capacity, and sensory evaluation. The methodology that was utilised in this research and an analysis of the findings are going to be detailed in the next part.

METHODOLOGY

Physico-chemical and sensory evaluations were performed on tomato khaman powder instant mix. The optimal instant tomato khaman powder with good quality and sensory qualities was chosen for 75-day storage.

Experimental design for packaging and storage of instant mix tomato khaman powder:

Independent Variables:

(i) Packaging materials: Two different types of packaging material

(a) M1 - Laminated aluminium foil pouches (LAFP)

(b) M2 – Low-density polyethene bag (LDPE)

(ii) Packaging condition: Two levels viz.

(a) T1 – with vacuum

(b) T2 – without vacuum

(iii) Treatments: 4

(iv) No. of replications:3

(v) Quality analysis:15 days interval

Table 1: Treatment combinations for storage of tomato khaman powder instant mix.

Treatment	Combinations	Details
T_1	M_1T_1	LAFP + with vacuum
T_2	M_1T_2	LAFP + without vacuum
T_3	M_2T_1	LDPE + with vacuum
T_4	M_2T_2	LDPE + without vacuum

Dependent Variables:

(i) Physical parameters: Colour, moisture content

(ii) Chemical parameters: Ascorbic acid, acidity, pH, TSS

(iii) Sensory evaluation: Colour, aroma, taste, overall acceptability

Packaging Materials. The packaging of the instant mix tomato khaman powder consisted of the use of laminated aluminium foil pouches with a thickness of 130 microns (LAFP) and low-density polyethene bags being 190 microns thick (LDPE) (Fig. 1). The LAFP's dimensions were 21 cm × 30 cm, whereas the LDPE's dimensions were 25.5 cm × 17.5 cm.

Fig. 1 (a): Storage of tomato khaman instant mix powder in ambient condition.

(b)

Fig. 1(b): Storage of tomato khaman instant mix powder.

Packaging of instant mix tomato khaman powder: Laminated aluminium foil pouches (LAFP) and low-density polyethene (LDPE) bags included the tomato khaman instant mix powder sample (113.23 g). LAFP and LDPE bags were vacuum-wrapped and packed without suction (Fig. 2, 3). The samples were kept at room temperature for as long as 75 days. At the Agricultural Environmental Engineering Laboratory in the Department of Processing and Food Engineering (PFE) at the College of Agricultural Engineering and Technology in Godhra, Gujarat, India.

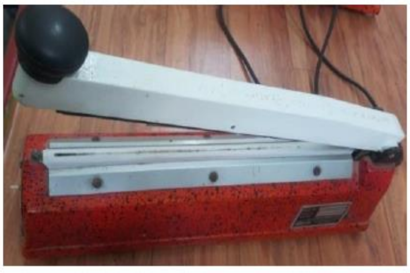

Fig. 2. Plastic sealing machine.

Fig. 3. Vacuum packaging machine.

Evaluation of responses. Every 15 days up to 2.5 months, samples of tomato khaman instant mix powder were subjected to analysis for colour, ascorbic acid, moisture content, acidity, pH and total soluble solids for quality analysis and sensory characteristics. Each time, a whole new packaged sample was opened up for examination.

RESULTS AND ANALYSIS

Tomato khaman instant mix powder was prepared under ideal conditions (mixing 17.04 grammes of tomato powder, 87.90 grammes of gramme flour, 5.46 grammes of sodium bicarbonate, and 2.83 grammes of salt). Tomato khaman instant mix powder was stored for 75 days and analysed every 15 days. Because of this, the product was tested for its physical qualities, such as colour L*, a*, b*, and moisture content. Ascorbic acid, pH, acidity and total soluble solids were also tested. This research examined the quick mix of tomato khaman powder's colour, aroma, taste, and overall appeal.

As storage time grew, the powder turned darker crimson. Heat processing usually alters its colour. Moisture, temperature, carbonyl compounds, organic acids, sugars, water activity, and oxygen produce non-enzymatic browning in preserved foods. In preserved papaya cereal flakes, non-enzymatic browning (NEB) changes impact colour-L*, colour-a* and colour-b*. The following table shows colour variation values L*, a* and b* during normal storage with different packaging materials.

Table 2: Variation of colour value L*, a*, b* throughout the storage period with varied packaging material at ambient conditions.

Treatments	Storage period, days																	
	L*						a*						b*					
	0	15	30	45	60	75	0	15	30	45	60	75	0	15	30	45	60	75
LAFP (Vac.)	19.0	18.62	18.23	17.57	17.27	17.13	15.6	16.2	17.2	18.1	19.1	20.3	-8.8	-15.47	-17.07	-22.57	-24.17	-24.27
LAFP (Without Vac.)	19.0	18.43	18.13	17.43	17.17	16.27	15.6	16.5	17.6	18.9	20.2	21.1	-8.8	-17.07	-17.67	-23.03	-26.07	-27.16
LDPE (Vac.)	19.0	18.37	18.07	17.27	17.07	16.17	15.6	17.3	19.0	20.2	22.3	22.9	-8.8	-17.27	-18.07	-24.57	-27.57	-28.67
LDPE (Without Vac.)	19.0	18.27	17.97	17.17	16.97	16.13	15.6	17.9	19.7	21.1	23.7	24.1	-8.8	-18.37	-18.77	-24.87	-28.07	-29.07
S. Em. ±		0.033	0.033	0.033	0.033	0.036		0.047	0.062	0.265	0.082	0.060		0.033	0.033	0.033	0.033	0.033
C.D.@ 5%		0.109	0.109	0.109	0.109	0.118		0.154	0.203	0.863	0.266	0.195		0.109	0.109	0.109	0.109	0.109
C.V. %		0.31	0.32	0.33	0.34	0.38		0.48	0.59	2.34	0.66	0.47		-0.34	-0.32	-0.24	-0.22	-0.21

LAFP= Laminated aluminium foil pouch, LDPE= Low density polyethylene, Vac.= Vacuum, ANOVA Table : Appendix –L

The following table illustrates the variation in ascorbic acid, acidity and moisture content that occurred throughout the storage period using various types of packaging material at room temperature.

Table 3: Variation of moisture content, ascorbic acid and acidity during storage period with varied packaging material at ambient condition.

Treatments	Storage period, days																	
	Moisture content,%(wb)						Ascorbic acid, mg/100g						Acidity,%					
	0	15	30	45	60	75	0	15	30	45	60	75	0	15	30	45	60	75
LAFP (Vac.)	8.2	8.2	8.3	8.3	8.3	8.3	14.7	14.7	14.7	14.7	14.7	14.7	0.20	0.20	0.20	0.21	0.21	0.21
LAFP (Without Vac.)	8.2	8.3	8.5	8.5	8.5	8.5	14.7	14.7	14.6	14.6	14.5	14.5	0.20	0.20	0.20	0.21	0.21	0.21
LDPE (Vac.)	8.2	8.4	8.6	8.6	8.6	8.6	14.7	14.5	14.5	14.4	14.3	14.3	0.20	0.20	0.20	0.21	0.21	0.21
LDPE (Without Vac.)	8.2	8.6	8.8	9.0	9.0	9.9	14.7	14.4	14.4	14.3	14.2	14.0	0.20	0.20	0.20	0.21	0.21	0.22
S. Em. ±		0.033	0.033	0.033	0.033	0.033		0.024	0.017	0.017	0.024	0.017		0.002	0.002	0.002	0.002	0.002
C.D.@ 5%		0.109	0.109	0.109	0.109	0.109		0.077	0.054	0.054	0.077	0.054		NS	NS	NS	NS	0.005
C.V. %		0.69	0.68	0.67	0.67	0.66		0.28	0.20	0.20	0.28	0.20		1.44	1.44	1.37	1.37	1.35

LAFP= Laminated aluminium foil pouch, LDPE= Low density polyethylene, Vac.= Vacuum, ANOVA Table : Appendix –L

The following table presents the variations in pH, total soluble solids and colour that occurred during the storage time using various types of packaging material while the conditions remained the same.

Table 4: Variation of pH, total soluble solid and colour during storage period with varied packaging material at ambient condition.

Treatments	Storage period, days																	
	pH						Total soluble solid, ° Brix						Colour					
	0	15	30	45	60	75	0	15	30	45	60	75	0	15	30	45	60	75
LAFP (Vac.)	5.3	5.3	5.3	5.2	5.2	5.2	5.5	5.4	5.4	5.4	5.3	5.3	8.0	8.0	7.8	7.8	7.8	7.8
LAFP (Without Vac.)	5.3	5.3	5.3	5.2	5.2	5.2	5.5	5.3	5.3	5.3	5.2	5.2	8.0	8.0	7.8	7.8	7.7	7.7
LDPE (Vac.)	5.3	5.3	5.3	5.2	5.1	5.1	5.5	5.2	5.2	5.2	5.1	5.1	8.0	8.0	7.7	7.7	7.6	7.6
LDPE (Without Vac.)	5.3	5.3	5.3	5.2	5.1	5.1	5.5	5.1	5.1	5.1	5.0	5.0	8.0	7.9	7.6	7.6	7.5	7.5
S. Em. ±		0.033	0.024	0.029	0.029	0.029		0.017	0.024	0.017	0.017	0.024		0.024	0.017	0.024	0.033	0.024
C.D.@ 5%		NS	NS	NS	0.094	0.094		0.054	0.077	0.054	0.054	0.077		0.077	0.054	0.077	0.109	0.077
C.V. %		1.10	0.77	0.97	0.98	0.98		0.55	0.78	0.55	0.56	0.80		0.51	0.37	0.53	0.76	0.53

LAFP= Laminated aluminium foil pouch, LDPE= Low density polyethylene, Vac.= Vacuum, ANOVA Table : Appendix –L

The table below displays the changes in aroma, taste, and general acceptability during storage when using various packaging materials under ambient conditions.

Table 5: Variation of aroma, taste and overall acceptability during storage period with varied packaging material at ambient condition.

Treatments	Storage period, days																	
	Aroma						Taste						Overall acceptability					
	0	15	30	45	60	75	0	15	30	45	60	75	0	15	30	45	60	75
LAFP (Vac.)	8.5	8.5	8.4	8.4	8.4	8.4	8.8	8.7	8.5	8.5	8.5	8.5	8.3	8.3	8.3	8.3	8.2	8.2
LAFP (Without Vac.)	8.5	8.5	8.3	8.3	8.2	8.2	8.8	8.7	8.5	8.4	8.4	8.4	8.3	8.3	8.3	8.2	8.1	8.1
LDPE (Vac.)	8.5	8.5	8.2	8.1	8.0	8.0	8.8	8.7	8.4	8.3	8.3	8.2	8.3	8.3	8.2	8.1	8.0	8.0
LDPE (Without Vac.)	8.5	8.4	8.1	8.0	7.9	7.8	8.8	8.6	8.3	8.2	8.2	8.1	8.3	8.2	8.1	8.0	7.9	7.9
S. Em. ±		0.029	0.024	0.017	0.029	0.029		0.017	0.017	0.017	0.017	0.037		0.017	0.024	0.024	0.024	0.024
C.D.@ 5%		NS	0.077	0.054	0.094	0.094		0.054	0.054	0.054	0.054	0.122		0.054	0.077	0.077	0.077	0.077
C.V. %		0.59	0.50	0.35	0.62	0.62		0.33	0.34	0.35	0.35	0.78		0.35	0.50	0.50	0.51	0.51

LAFP= Laminated aluminium foil pouch, LDPE= Low density polyethylene, Vac.= Vacuum, ANOVA Table : Appendix –L

Table 5 shows that the overall acceptability of tomato khaman instant mix powder decreased from 8.30 to 8.20, 8.10, 8.00 and 7.90 for LAFP with as well as without vacuum, polyethene bags with as well as without vacuum, and powder packed in LAFPs with vacuum after 75 days. Significant storage variance ($P<0.05$). Physical and chemical parameters of tomato khaman instant mix powder showed that laminated aluminium foil pouches with vacuum packing out performed those without as well aspolyethene bags with and without vacuum packaging during the 75-day storage term. The study such as Tarkeshwar and Pradip (2023) also have almost similar results.

CONCLUSION

Optimized tomato khaman instant mix powder was stored in LAFP and LDPE bags with and without vacuum packaging for 75 days (2.5 months). Storage reduced average colour-L* values from 19.0 to 16.13. During storage, the average colour-a* and colour-b* values increased from 15.60 to 24.10 and -8.80 to -29.07. Storage reddens and yellows colour-a* and colour-b*. Vacuum packing with an LAFP had the lowest average moisture content among polyethene bags with and without vacuum packaging. Tomato khaman instant mix powder's ascorbic acid reduced from 14.70 to 14.00 mg/100g after 75 days. Laminated aluminium foil pouches with vacuum sealing had the most ascorbic acid after 75 days. Hence, vacuum-packed LAFPs were ideal for product storage.

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