Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; SP1: 55-57

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(Special Issue- 1)
2nd International Conference
"Food Security, Nutrition and Sustainable Agriculture - Emerging Technologies"
(February 14-16, 2019)

Effect of different types of packaging material on quality and shelf life of tomato

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Abstract
An investigation was conducted at agriculture Lab, Department of Agriculture, D.A.V College, Abohar, Punjab during academic year 2018 to study the effect of different types of wrapping material on quality and shelf life of Tomato. The different packaging material were polythene bags, newspaper sheet, aluminium foil and open air as a control were used for experiment. The fruits were kept in refrigeration. The effect of different packaging on change in physiological loss in water, specific gravity, spoilage percentage, TSS and Titrable acidity was observed. The different treatments showed variation in physiological and physical characters. Out of these four treatments aluminium foil showed best results as compared to other treatments. The obtained results indicated that less decrease in physiological loss in weight, specific gravity, spoilage percentage, TSS and titrable acidity were recorded in fruits covering with aluminium foil and maximum decrease in physiological loss in weight, specific gravity, spoilage percentage, TSS and titrable acidity were recorded in control after 23 days of storage.

Keywords: Packaging material, life of tomato, physiological

Introduction
Tomato (*Lycopersicon esculantum Mill.*) is the most important vegetable crop including tropical, sub-tropical and temperate regions. Worldwide tomato ranks third in area and production after potato and sweet potato but ranks first among processed vegetables. Globally, tomato is cultivated in 882.0 thousand ha area with 18735.9 thousand million tonnes production and average productivity is 21.2 MT/ha. In India, Andhra Pradesh ranked first in area and production are 167.72 thousand hectare and 3354.47 thousand million tonnes and average productivity is 20.0 MT/ha respectively (National Horticulture Board) [1]. Cultivated tomato originated in the New World while the Andean zone is likely to be the centre of origin of wild tomatoes. Earlier Peru was considered as centre of domestication of tomato. However, the historical, linguistic and ethno-botanical evidences favour Mexico particularly Vera Cruz – Puebla areas as the source of the cultivated tomatoes that were first transported to the old World. *Lycopersicon esculantum var. cerasiforme* is an immediate ancestor of cultivated tomato *Lycopersicon esculantum.* Tomato was introduced into Europe shortly after 1521, when Spanish explorer Cortez conquered Mexico. The first tomatoes introduced in Europe were yellow in coloured and red type were introduced many year later. From Spain, the tomato spread to Italy, France and other European countries. The Italians grew it around 1550. It was introduced into England around 1575. The colonists first brought tomato to North America from Britain in late 18th century. In USA, Thomas Jefferson first grew it in Virginia in 1781. The England traders of the East India Company introduced tomato into India in 1822 (Dhaliwal) [2]. It was reported that the fresh tomatoes to have a limited storage life, which is usually enhanced by various factor such as physical injuries, high storage temperature, high moisture content and high ethylene production at different stage of ripening. He attributed the high postharvest losses of tomato in the developing countries to bumper harvest during the peak season, causing the supply of tomato to exceed demand in the peak season and scarcity during the off-season, thus diminishing the grower's returns. Therefore, post harvest loses have great economic implications which do not only affect the local farmers but rather the

economy of entire nation. Moreover, the perishable nature of tomato and its associated consequences necessitate an exploration into appropriate postharvest technologies to extend the storage life without compromising the quality. (Mutari and Debbie,) [3].

Material and Method

The experiment was carried out during August-September 2018. The fruits were harvested from the field of Mr. Surender kumar at village Ramsara and packed in plastic crates immediately and transported to Agriculture Lab, Deptt. of Agriculture, D.A.V College, Abohar. Then fruits were washed in running water to remove dust and chemicals residues present on the surface of fruits. The fruits were graded into uniform size and fruits were spread on newspaper sheets and let them to dry out for half an hour. The objective of the study was to calculate the physical and chemical characteristics such as change in physiological loss in weight, specific gravity, spoilage percentage, TSS and Titrable acidity of each fruit from different treatment at 2 days interval. The fruits were placed in polyethylene bags, news paper and aluminium foil with or without ventilation and sealed. There were about 4 treatments.

Physiological loss in weight (%) - The fruit was weighed on successive intervals after the application of treatment and loss in weight at each interval was expressed in percent of initial weight for every sample.

$$PLW = \frac{\text{Initial weight of fruit} - \text{Final weight of fruit}}{\text{Initial wight of fruit}} \times 100$$

Specific gravity (g/ml) - The specific gravity of tomato fruit was determined by dividing the weight of each fruit by the volume of water displaced by it.

$$\text{Specific gravity} = \frac{\text{Weight of fruit (g)}}{\text{Volume of water displaced by fruit (ml)}}$$

Spoilage percentage (%) - The spoilage percentage was calculated by dividing the number of the fruits spoiled by total number of fruits stored and multiplying the result by 100.

$$\text{Spoilage percentage} = \frac{\text{Weight of spoiled fruit}}{\text{Total weight of fruit}} \times 100$$

Total soluble solid: It was determined with the help of Hand Refractrometer. One or two drops of juice will be placed on refractrometer prism and TSS percentage on scale is recorded.

Titratable acidity (%): A known weight of fruit sample was crushed and taken in 100 ml volumetric flask and volume will be made up by adding distilled water. After filtration, 10 ml of filterate was taken in separate conical flask and titrated against 0.1 N sodium hydroxide using phenolphthalein as an indicator. The end point was determined by appearance of faint pink color. Titratable acidity will be calculated by using the formula

$$\text{Titratable acidity (\%)} = \frac{\text{Volume of NaOH} \times 0.0064}{\text{Volume of Juice used (10 ml)}} \times 100$$

Treatment

RR_1- Wrapped with paper
RR_2- Wrapped with aluminium foil
RR_3- Wrapped with polythene
RR_4- Control

Result and Discussion

Physical parameters

Change in physiological loss in weight

In refrigeration, the minimum physiological loss in weight (%) was recorded in fruits packed in aluminium paper (RR_2) followed by fruits packed in news paper sheet (RR_3) and packed in polythene bags (RR_1) at 3rd, 6th, 9th, 12th, 15th, 18th and 21st days of storage respectively. And the maximum physiological loss in weight (%) was observed in control (unpacked fruits) (RR_4) at 3rd, 6th, 9th, 12th, 15th, 18th days of storage respectively. (Rajkumar and Mitali) [4] who concluded that the minimal weight loss per day was then followed by perforated polythene (1.65% and 0.27%) and wax coating (3.80% and 0.92%) at room temperature (30^0C) and in the refrigerator (4^0C) respectively; while control showed 8.75% and 2.74% of weight loss per day at room temperature and refrigerator respectively. (Hayat *et al.*) [5] Analysis of variance showed highly significant results ($P<0.05$) among different treatments and storage intervals, the comparison of treatment means showed that maximum weight loss (13.57%) was observed in T_0 (control) whereas the lowest (5.65%) was noted in T_6 (2% calcium chloride).

Specific gravity (g/ml)

In refrigeration, the maximum specific gravity was recorded in fruits packed in aluminium paper (RR_2) followed by fruits packed in news paper sheet (RR_3) and packed in polythene bags (RR_1) at 3rd, 6th, 9th, 12th, 15th, 18th and 21st days of storage respectively. The minimum specific gravity was observed in control (unpacked fruits) (RR_4) at 3rd, 6th, 9th, 12th, 15th, 18th days of storage respectively. (Pratap *et al.*) [6] who concluded that the maximum value (1.260%) was observed in T_5 on 3rd day of storage and minimum was observed in T_0 (0.513%) on 9th day of storage. Specific gravity of sapota decrease with increasing the period of storage due to decrease in weight of fruit irrespective of packaging material used.

Spoilage percentage (%)

In refrigeration, the minimum spoilage percentage (%) was recorded in fruits packed in aluminium paper (RR_2) followed by fruits packed in news paper sheet (RR_3) and packed in polythene bags (RR_1) at 3rd, 6th, 9th, 12th, 15th, 18th and 21st days of storage respectively. And the maximum spoilage percentage (%) was observed in control (unpacked fruits) (RR_4) at 3rd, 6th, 9th, 12th, 15th and 18th days of storage respectively. (Dhall *et al.*) [7] who concluded that on the 28th day of storage the maximum loss was observed in fruit which are packed in cling film i.e. 9.5% followed by low density polythene (LDEP) and control unpacked fruits i.e. 8.0% respectively. The minimum loss was observed in fruit which are packed in high density polythene (HDEP) i.e. 6.0%. (Kaur *et al.*) [8] who concluded that the spoilage in fruits packed in different packaging material was maximum (6.91%) in wooden boxes followed by (6.3%) crates and CFB boxes, which were significantly higher than other packaging treatments. Minimum spoilage was (3.1%) recorded in fruits packed in CFB boxes with HDEP liners.

Chemical parameters

TSS-Total soluble solids

In refrigeration, the highest TSS was recorded in fruits packed in aluminium paper (RR_2) followed by fruits packed in news paper (RR_3) and packed in polythene bags (RR_1) at 3rd, 6th, 9th,

12th, 15th, 18th and 21st days of storage respectively. And the lowest TSS was observed in control fruits (RR_4) at 3rd, 6th, 9th, 12th, 15th and 18th days of storage respectively. (Rajkumar and Mitali,) [4] who concluded that the fruits treated with 2% wax emulsion coating and sealed polythene increased the percentage of TSS up to 97.67% and 86.05% at room temperature and 155.81% and 174.42% in refrigerator respectively; whereas perforated polythene at 4.5^0C showed 141.86% increase in TSS, compared with control 62.79% at room temperature and 132.56% at 4.5^0C.

Titrable acidity

In refrigeration, the highest titrable acidity was recorded in fruits packed in aluminium paper (RR_2) followed by fruits packed in news paper (RR_3) and packed in polythene bags (RR_1) at 3rd, 6th, 9th, 12th, 15th, 18th and 21st days of storage respectively. And the lowest titrable acidity was observed in control fruits (RR_4) at 3rd, 6th, 9th, 12th, 15th and 18th days of storage respectively. (Panda *et al.*) [9] who concluded that under room temperature storage condition, no significant variation in titrable acidity of fruits packed with different packaging films was found, however, over the storage period, significant variation (at 5% level of significance) in titrable acidity was observed. Maximum titrable acidity was noted on the 0th day (0.91%) followed by 1st (0.85%), 2nd (0.81%), 3rd (0.75%) and minimum on the 4th (0.70%) day of storage. The interaction between the packaging films and storage period was non-significant.

Observations and Tables

Table 1: Effect of different packaging material and storage condition on physiological loss in weight

Days of observation	0	3	6	9	12	15	18	21
RR_1	0	2.40	2.96	3.90	4.16	5.83	6.26	6.91
RR_2	0	1.61	1.73	2.30	3.03	3.96	4.26	5.17
RR_3	0	2.00	2.93	3.86	3.83	5.13	5.70	6.73
RR_4	0	2.26	2.66	3.47	3.76	5.17	7.01	-

Table 2: Effect of different packaging material and storage condition on specific gravity of the fruits

Days of observation	0	3	6	9	12	15	18	21
RR_1	0	0.97	0.93	0.90	0.84	0.80	0.80	0.71
RR_2	0	1.14	1.12	1.09	1.05	1.00	0.99	0.96
RR_3	0	1.10	1.07	1.01	0.96	0.93	0.91	0.88
RR_4	0	1.03	0.99	0.95	0.80	0.73	0.67	-

Table 3: Effect of different packaging material and storage condition on spoilage percentage of fruits

Days of observation	0	3	6	9	12	15	18	21
RR_1	0	2.77	5.33	7.91	11.41	13.15	14.96	18.41
RR_2	0	1.66	3.37	4.00	5.72	8.21	10.00	13.88
RR_3	0	3.42	5.70	8.00	10.87	13.35	15.09	17.94
RR_4	0	2.44	5.65	9.10	13.98	15.83	18.74	-

Table 4: Effect of different packaging materials and storage conditions on TSS of fruits

Days of observation	0	3	6	9	12	15	18	21
RR_1	0	3.16	3.46	3.76	3.96	4.70	4.56	4.61
RR_2	0	3.06	3.70	4.83	5.67	6.10	6.26	6.29
RR_3	0	3.06	3.51	4.27	4.99	5.56	5.54	5.60
RR_4	0	3.03	3.36	3.83	3.96	4.13	3.63	-

Table 5: Effect of different packaging materials and storage conditions on Titrable acidity of fruits

Days of observation	0	3	6	9	12	15	18	21
RR_1	0	0.28	0.29	0.30	0.29	0.29	0.28	0.23
RR_2	0	0.29	0.31	0.32	0.33	0.32	0.34	0.46
RR_3	0	0.28	0.30	0.31	0.31	0.29	0.33	0.32
RR_4	0	0.28	0.30	0.30	0.29	0.28	0.28	-

Conclusion

From the experiment effect of different storage packaging material on physical and chemical properties and shelf life of tomato (*Lycopersicon esculantum* L.) Under refrigeration a conclusion can be made that storage in aluminium packaging increase the shelf life of tomato up to 23 days with less effect on its quality.

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