Technology Section

Pak. j. sci. ind. res., vol. 37, nos. 6-7, June - July 1994

EFFECT OF DIFFERENT STORAGE TECHNIQUES ON THE RIPENING BEHAVIOUR OF TOMATOES (*LYCOPERSICUM ESCULENTUM* MILL) VARIETY ROMA

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(Received October 12, 1992; revised February 12, 1994)

Tomato (*Lycopersicum esculentum* Mill) variety Roma is a major crop growing in Pakistan. Due to its perishable nature, storage is a problem. Attempts were made to investigate the storage of tomatoes using different techniques during 1989-92. Results showed that the ripening of tomatoes variety Roma can be controlled for 40 days with percentage of fruit rotting 23.80 - 29.79 depending upon the treatments in coarse moistened saw dust or fine moistened saw dust with or without dipping in 0-4% $CaCl_2$ at ambient pressure for 5 min.

Key words: Post harvest technology, Tomatoes, Storage.

Introduction

The storage of tomatoes in fresh form is very difficult due to its perishable nature. The storage life of tomatoes was prolonged by about 3 weeks in moistened sawdust by slowing down the rate of ripening and shrivelling due to transpiration [1]. Small uptakes of Ca can be achieved by dipping tomatoes at ambient pressure in 4 and 8% $CaCl_2$ solutions [2-3]. The activity of mitochondria and two pectic enzymes (pectin estrase and polygalacturonase) was inhibited by the addition of high concentrations of Ca ions [4].

The biochemical changes are influenced by growth, maturation and environment of tomato fruit. The sugar content of tomato fruit juices increases during ripening whereas the acidity declines after the first appearance of yellow colour [5-6].

Large amount of tomatoes are produced every year in Pakistan. Apart from their use in a fresh state as salad, an adequate amount is utilised for processing. Due to improper harvesting, handling, storage and transportation of tomatoes, post harvest losses occur at each stage. Ultimately, the farmer can suffer a great economic loss. To overcome the post harvest losses, studies were conducted to investigate low cost on-farm primary storage of tomatoes using different storage techniques at ambient conditions.

Materials and Methods

The studies on the storage of tomatoes variety Roma were conducted during 1989-92 at Post Harvest Research Centre, Ayub Agricultural Research Institute, Faisalabad.

The tomatoes variety Roma were picked at green turning to yellow, fully mature stage, 90 days after transplanting the nursery (locally called as 'Gadra' stage) from the field to the laboratory (one kilometer away from the field). The tomatoes were washed by the tap water and dipped in $CaCl_2$ 0,2,3 and 4% solutions for 5 min. at ambient pressure and kept in coarse moistened sawdust (CMSD), fine moistened saw dust (FMSD) or perforated wooden crates (PWC). The treatments are given in Table 1.

CMSD and FMSD are the byproducts of saw when wood is sawed. Both the sawdusts were procured from the same species of wood i. e. Shesham for the studies on the storage of tomatoes. The sawdusts (coarse and fine) were moistened by sprinkiling with water once each day between 8 and 8.30 a.m. The surplus water was drained from the perforation of plastic trays in which the sawdust was filled. The physico-chemical characteristics for titrable acidity percentage and total soluble solids in brix were carried out according to the standard methods [7] during storage.

The weight loss percentage and the fruit rotting percentage were also recorded to evaluate the storage ability of tomatoes. The data was analysed by the analysis of varience method in accordance with CRD multifactorial and Student - Neuman - Keul's Multiple Range Test [8].

Results and Discussion

The physico-chemical characteristics for weight loss percentage, fruit rotting percentage, acidity percentage and total soluble solids in brix of tomato juice were determined during storage of 40 days after 8 days interval.

The F values pertaining to all the parameters were highly significant for sawdust (A) and calcium (B) treatments as shown in Table 2. The storage (C) is also highly significant for titrable acidity percentage, total soluble solids (TSS), weight loss percentage and fruit rotting percentage. The interactions i. e., A x B (sawdust x calcium), A x C (sawdust x storage), B x C (calcium x storage) and A x B x C (sawdust x calcium x storage) were highly significant for all the parameters as described in Table 2.

The acidity percentage in FMSD and CMSD is non significant while TSS was highest in PWC followed by CMSD

and FMSD stored tomatoes. However, the weight loss percentage was highest in PWC followed by FMSD and C M SD. The fruit rotting percentage is minimum overall in CMSD stored tomatoes (23.80%) as compared with FMSD (29.79%) and PWC (53.47%) stored tomatoes as revealed from Table 3. Due to these significant results, one can draw the inference that CMSD may be the best storage media for tomatoes variety Roma for delaying its ripening.

The $CaCl_2$ 4% has the significant effect on the acidity of tomatoes as compared with other doses. The total soluble solids were effected by 2-3% $CaCl_2$ dose as compared with 0 and 4% $CaCl_2$ dose. The effect of $CaCl_2$ on the physico-chemical characteristics of tomatoes showed that without $CaCl_2$, the maximum weight loss was recorded, whereas, there is no statistically significant effect for 2-4% $CaCl_2$ dose. The fruit rotting was statistically effected significantly only by 3 and 4% $CaCl_2$ dose as evident from Table 4.

The titrable acidity percentage, total soluble solids in brix, weight loss percentage and fruit rotting percentage were increased during storage as shown in Table 5. The titrable acidity of tomato juice remained non significant overall upto 8 days of storage i. e., uptill the colour of tomatoes remained

TABLE 1. SHOWING THE DOSE OF $CaCl_2$ AND STORAGE MEDIUM IN EACH TREATMENT.

Treatment	$CaCl_2$ dose (%)	Storage medium for tomatoes
T1	0	CMSD*
T2	0	FMSD**
T3	0	PWC***
T4	2	CMSD
T5	2	FMSD
T6	2	PWC
T7	3	CMSD
T8	3	FMSD
T9	3	PWC
T10	4	CMSD
T11	4	FMSD
T12	4	PWC

* Coarse moistened saw dust. ** Fine moistened saw dust. *** Perforated wooden crates.

TABLE 2. SHOWING F VALUES FOR PHYSICO-CHEMICAL CHARACTERISTICS OF TOMATO VARIETY ROMA.

Due to	df	F Value			
		Acidity (%)	TSS (brix)	Weight loss (%)	Rotting (%)
Sawdust (A)2	1	16.06**	76.31**	961.54**	455.77**
Calcium (B)	3	5.66**	3.66**	10.52**	4.366**
AxB	6	8.27**	93.01**	12.03**	10.36**
Storage (C)	5	34.31**	265.41**	183.59**	491.67**
AxC	10	10.54**	53.15**	88.50**	20.75**
BxC	15	2.72**	6.69**	2.66**	0.987
AxBxC	30	3.12**	13.24**	0.96**	1.034*
Error	144	-	-	-	-
Total	215				

** Highly significant at 5% level.

TABLE 3. EFFECT OF SAWDUST ON THE PHYSICO-CHEMICAL CHARACTERISTICS OF TOMATO VARIETY ROMA.

Type of sawdust	No. of observations used to calculate a mean = 72			
	Acidity (%)	TSS (brix)	Weight loss (%)	Rotting (%)
CMSD*	0.37 B	5.02 B	3.62 C	23.80 C
FMSD**	0.38 B	4.82 C	5.25 B	29.79 B
PWC***	0.47 A	5.07 A	33.63 A	57.47 A
$\underline{S}_{\bar{x}}$ at alpha = 0.05	0.00527	0.01491	0.5393	0.8413
EMS	0.002	0.016	20.94	50.96

Any two means not sharing a letter differ significantly at 5% level of probability.* Coarse moistened sawdust. **Fine moistened sawdust. *** Perforated wooden crates (control).

TABLE 4. EFFECT OF CALCIUM CHLORIDE ON PHYSICO-CHEMICAL CHARACTERISTICS OF TOMATO VARIETY ROMA.

$CaCl_2$ dose (%)	No. of observations used to calculate a mean =54			
	Acidity (%)	TSS (brix)	Weight loss (%)	Rotting (%)
0	0.40 B	4.96 AB	16.86 A	34.86 B
2	0.40 B	5.00 A	12.19 B	36.41 B
3	0.40 B	5.00 A	14.16 B	37.09 AB
4	0.43 A	4.93 B	13.10 B	39.72 A
$\underline{S}_{\bar{x}}$ at alpha = 0.05	0.006086	0.01721	0.6227	0.9714
EMS	0.0020	0.0160	20.94	50.96

Any two means not sharing a letter differ significantly at 5% level of probability.

TABLE 5. EFFECT OF STORAGE ON THE PHYSICO -CHEMICAL CHARACTERISTICS OF TOMATO VARIETY ROMA.

Storage in days	No. of observations used to calculate a mean = 36			
	Acidity (%)	TSS (brix)	Weight loss (%)	Rotting (%)
0	0.35 C	4.50 F	0.00 F	0.00 F
8	0.36 C	4.75 E	6.00 E	18.22 E
16	0.40 B	4.86 D	11.56 D	30.07 D
24	0.46 A	5.03 C	16.68 C	44.46 C
32	0.45 A	5.24 B	22.50 B	56.88 B
40	0.41 B	5.45 A	27.74 A	72.49 A
$\underline{S}_{\bar{x}}$ at alpha = 0.05	0.00745	0.02108	0.7627	1.190
EMS	0.0020	0.0160	20.94	50.96

Any two means not sharing aletter differ significantly at 5% level of probability.

green. The titrable acidity is then increased from 0.40 to 0.46% from 16 to 24 days of storage and then decreased to 0.45% after 32 days and to 0.41% after 40 days of storage. It is clearly evident from the data that the titrable acidity declines after the first appearance of yellow colour i.e., after 16 - 24 days of storage [5-6]. The total soluble solids of tomato juice increased overall from 4.50 to 5.45 brix during storage of 40 days [5-6]. The weight loss percentage and tomato fruit rotting percentage was increased from 0.00 to 27.74 and 0.00 to 72.49, respectively, after 40 days of storage. The results lead to the conclusion that the storage have significant effect on all the qualitative and quantitative parameters.

Hence the inference can be drawn that $CaCl_2$ application at ambient pressure have minor effect on the storage ability of tomatoes variety Roma. However, CMSD proved a good media for storage of tomatoes due to better aeration as compared with FMSD. On-farm low cost primary storage of tomatoes can be adapted by the farmers with the use of CMSD to regulate their market supply through ripening delay of tomatoes.

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