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Effect of Fruit Ripening Agents on Composition and Storage Quality of Muskmelon

Bindu, Manoj Sharma*, Jatinder Manan and Amandeep Kaur

Krishi Vigyan Kendra, Kapurthala 144620, Punjab, India
**Corresponding author*

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A B S T R A C T

A survey was conducted in the niche areas of muskmelon and found that hybrids Bobby and Muskan were suitable for long distant transportation. 30 fruits each of Bobby and Muskan hybrids were obtained from farmer's field to carry out this experiment in the Krishi Vigyan Kendra, Kapurthala laboratory during the months of May-June, 2017. This experiment was carried out for 5 days keeping in view the maximum and after a gap of 24 hr, two muskmelon fruits each from all three treatments were weighed, cut and measured for different parameters daily for consecutive 5 days. The data revealed that fruit weight of Muskan on 3rd day (0.949 g) was at par with initial harvest weight of Bobby (0.933 g) revealing that initial weight of fruit had its impact else ripening agent had no impact on variation in fruit weight. TSS of Muskan on 3rd day (12.217 ^{o}Brix) was at par with Bobby on 1st day (12.4317 ^{o}Brix), although on 5th day in Muskan, the TSS was significantly higher than Bobby on 1st day, thus, genetic makeup of hybrid plays major role in increasing TSS than ripening agents. pH in case of Bobby increased by 18.4 per cent and 14.8 per cent for Muskan with the passage of time. The pH value was maximum for both the hybrids with calcium carbide, at par with Ethephone and statistically higher than control in both the hybrids. In fruit diameter decrease was gradual with the duration but its impact was more on Muskan than Bobby, which might be due to initial higher fruit diameter of the fruit. It can be concluded that muskmelon fruits can be ripened naturally at room temperature during the months of May-June as the day temperature exists between 40 to 45^{o} C and there is no need to make use of any ripening agent while transporting the fruit to the distant markets.

Introduction

Muskmelon (*Cucumis melo* L.) is one of the important fruit in the world due to its refreshing and tasty flesh; pleasant aroma and economic viability. Muskmelon consumption is associated with its potential human health benefits because it contains naturally occurring vitamins, minerals and pigments which provide antioxidant and anti-inflammatory properties (Ismail *et al.*, 2010) and anti-diabetic benefits (Kenny *et al.*, 2013). Muskmelon fruit is perishable commodity due to its high water content, so harvesting at proper stage and its proper transportation is must to enhance its shelf life after harvest. Fruit ripening is an irreversible phenomenon involving a series of physiological, biochemical and organoleptic changes that leads to development of soft and edible fruit with desirable quality parameters (Prasanna *et al.*, 2007). Sugar content and

firmness of the fruit is the major criteria used in judging the quality of muskmelon.

In Punjab, Kapurthala district has developed niche of muskmelon from where the fruit is transported to the entire country. About 1,700ha area of the district is under muskmelon and water melon crops. The major cropping sequence followed by the farmers is paddy-potato-muskmelon/watermelon/spring maize/sunflower. The choice of the crop to be sown in the area depends upon the marketing experience gained during the last year. It is worth to mention that during the year 2016-17, area under sunflower decreased from 5,000 ha to 500 ha. The major reason in decline of area was low selling price of sunflower i.e. Rs 2,800/q, on the other hand, area under spring maize has increased manifolds due to its high productivity of about 80-85 q/ha, however it is a long duration crop of about 110-120 days and growing period extends from February to June leading to low water use efficiency.

Another option with the farmers is cultivation of muskmelon and water melon crops in the area because both these crops are highly remunerative. Kaur *et al.,* (2017) reported that per cent area under different muskmelon hybrids was found to be Farm Glory (35%), Madhu (30%), Golden Glory (25%), Kesar (7%) and Bobby, Muskan, Inthanon, Sunny and Sharda Chand (3%). Similarly, it was also revealed that a large variation was found in the performance of different hybrids regarding yield and various fruit quality parameters like TSS, shelf life, pH and netting etc.

The growers of this crop sell the fruits throughout the country in order to enhance the margin of profit and harvest the crop at the onset of ripening, pack it in net bags or corrugated boxes and load it in trucks for its transportation to distant markets. They use banned calcium carbide (CaC_2) for artificial ripening of muskmelon fruits during transportation so that it develop sweetness and texture by the time it reach to consumers. According to Singal *et al.,* (2012), the commercial practice of using the ripening agents to artificially ripen the fruits before retailing to the consumers in very common. A number of chemicals are used for ripening the fruits and vegetables and the list of these artificial ripening agents which are widely used in India is collected by Dhambare (2013). Most of these chemicals are very harmful for human health. Dhatt and mahajan (2007) has also reported that in India and many other developing countries banana and mango are ripened with the use of $CaCl_2$, which releases acetylene on interaction with moisture coming from fruits. Industrial grade calcium carbide contains traces of arsenic and phosphorus hydride which is harmful to human health and its use for ripening of fruits is banned in India under section 44-AA of PFA rules.

On the other hand, Ethylene, a naturally produced gas after harvesting of some fruits and vegetables acts as a safe ripening agent. A very small concentration (1 ppm) of ethylene in air is sufficient to promote the fruit ripening process Ruchita, 2008). Externally applied ethylene is likely to trigger or initiate the natural ripening process of apple, avocado, banana, mango, papaya, pineapple and guava, and therefore, can be marketed before the predicted time. Ethephon is often considered better than calcium carbide because pineapple, banana and tomato treated with 1000 ppm of ethephon required less time for ripening (48, 32 and 50 h) than other treated fruits as compared to non-treated fruits. The fruits ripened with ethephone have more acceptable colour than naturally ripened fruits (Stejskal *et al.*, 2006) and have longer shelf life than fruits ripened with CaC_2.

Ethephon is decomposed into ethylene, bi-phosphate ion and chloride ion in aqueous solution. The released ethylene further fastens up the ripening process.

Ministry of Agriculture (MoA) has clarified that the fruits are exposed to ethylene gas in low concentration to trigger their ripening. It is considered safe in the low concentration (0.001-0.01%) depending upon the crop, variety and maturity. Therefore, the present study was carried out with the objective to determine the effect of fruit ripening agents on composition and storage quality of muskmelon fruits in order to verify the farmers practice whether is there any beneficial effect or not?

Materials and Methods

Fruit Source

A survey was conducted in the niche areas of muskmelon and found that hybrids Bobby and Muskan were suitable for long distant transportation. Therefore, commission agents or traders prefer both these hybrids due to their desirable size and keeping quality. Hence, 30 fruits each of Bobby and Muskan hybrids were obtained from farmer's field to carry out this experiment in the Krishi Vigyan Kendra, Kapurthala laboratory during the months of May-June, 2017.

Sample preparation

Samples of fruits which were free from defects, have similar size, background colour with developed net were randomly selected at the onset of maturity stages. The fruits were harvested with sharp knives and then carefully taken out of the fields. The different treatments applied were

T1: Untreated control, 10 muskmelon fruits were kept without any treatment in a corrugated box.

T2: Treatment with Calcium Carbide (Farmer's method): Ten fruits were weighed, packed in a corrugated box and calcium carbide wrapped in newspaper was kept in the box @ 2g/kg fruits. The reaction of chemical was initiated by sprinkling a small quantity of water on it.

T3: Treatment with Enthrone (Recommended ripening agent): A solution of 500ppm of ethephon was prepared. Ten muskmelon fruits were dipped in it for 5 minutes and dried under the fan. Later on treated fruits were packed in corrugated box.

Observation recorded

This experiment was carried out for a period of 5 days keeping in view the maximum days required to reach the remotest market.

After a gap of 24 hrs, two muskmelon fruits each from all three treatments were weighed, cut and measured for different parameters daily for consecutive 5 days.

The data thus recorded were analysed statistically by using split-split design as given by Sheoran *et al.,* (1998).

Physical parameters

Different physical parameters determined were fruit weight, fruit diameter, flesh thickness, rind thickness as per standard procedures.

Chemical parameters

The total soluble solids (TSS) were determined from fresh strained thoroughly stirred juice of fruits on each sampling date with the help of a hand refractometer and expressed as percentage soluble solids.

The pH of the samples was determined with the help of pH meter.

Results and Discussion

Fruit weight

The effect of ripening agents was found to be non-significant, although significant effect was observed with the days after harvest (Table 1). A significant variation was observed in the fruit weight with passage of every day and it had a positive interaction with the hybrids (Table 2). The overall decrease in fruit weight was observed to be 9.86 and 6.73 per cent in hybrid Bobby and Muskan, respectively. The interaction revealed that fruit weight of Muskan on 3rd day (0.949 g) was at par with initial harvest weight of Bobby (0.933 g). Hence, initial weight of fruit had its impact else ripening agent had no impact on variation in fruit weight.

Rind thickness

In order to transport muskmelon fruits to a long distance, traders prefer solid fruits and therefore, rind thickness was measured. It was found that there was no significant effect of both ripening agents on the rind thickness of fruits, however, there was a gradual decrease in the thickness in all three treatments (Table 3).

TSS level

The main purpose of using these ripening agents was to increase TSS level of fruits but the data (Table 4) showed that there was no significant effect of ripening agents on the TSS values. However, an increase in TSS level was observed in all three treatments from day 1 to day 5. On the other hand, significant difference was observed in TSS values of both hybrids (Table 5).

Interaction effect between the hybrids and number of days of treatment revealed that TSS of Muskan on 3rd day (12.217 ^{o}Brix) was at par with Bobby on 1st day (12.4317 ^{o}Brix), although on 5th day in Muskan, the TSS was significantly higher than Bobby on 1st day, thus, genetic makeup of hybrid plays major role in increasing TSS than ripening agents.

pH value

This parameter was significantly affected with the use of ripening agents as the interaction effect between hybrids and ripening agents was found to be 0.075. Initial pH values of both these hybrids was nearly in the same range (5.15 and 5.05), which after treatment with ripening agents increased to 5.8-6.15 in both the hybrids (Table 6).

Table.1 Effect of number of days and ripening agents on fruit weight of different hybrids

Days	Bobby			Muskan		
	Control	CaC_2	Ethephone	Control	CaC_2	Ethephone
1	0.932	0.943	0.925	1.007	1.077	0.99
2	0.914	0.92	0.907	0.962	1.007	0.964
3	0.906	0.898	0.873	0.936	0.971	0.939
4	0.882	0.857	0.857	0.904	0.946	0.907
5	0.856	0.831	0.837	0.893	0.926	0.895

Table.2 Interaction between hybrids and number of days on fruit weight

Hybrid	Days after harvest					Mean (Hybrid)
	1	2	3	4	5	
Bobby	0.933	0.914	0.892	0.865	0.841	0.889
Muskan	1.024	0.977	0.949	0.918	0.905	0.955
Mean (Days)	0.979	0.945	0.920	0.892	0.873	
CD (Day)		**0.011**	**CD (Hybrid X day)**			**0.016**

Table.3 Effect of number of days and ripening agents on rind thickness (cm)

Days	Bobby			Muskan		
	Control	CaC_2	Ethephone	Control	CaC_2	Ethephone
1	0.48	0.485	0.485	0.405	0.38	0.38
2	0.465	0.43	0.425	0.38	0.37	0.345
3	0.44	0.415	0.405	0.36	0.34	0.31
4	0.405	0.395	0.365	0.33	0.315	0.30
5	0.39	0.385	0.355	0.31	0.30	0.295
CD (Days)			**0.011**			

Table.4 Effect of number of days and ripening agents on TSS (^{o}Brix) of different hybrids

Days	Bobby			Muskan		
	Control	CaC_2	Ethephone	Control	CaC_2	Ethephone
1	12.1	12.55	12.30	11.10	11.25	11.30
2	12.95	13.30	12.95	11.55	11.70	11.75
3	13.75	13.90	14.00	12.25	12.30	12.10
4	14.4	14.65	14.65	12.5	12.40	12.30
5	14.85	14.95	14.75	12.7	12.50	12.55

Table.5 Interaction between hybrids and number of days on TSS of fruits

Hybrid	Days after harvest					Mean (Hybrid)
	1	2	3	4	5	
Bobby	12.317	13.067	13.883	14.567	14.85	13.737
Muskan	11.217	11.667	12.217	12.40	12.583	12.017
Mean (Days)	11.767	12.367	13.05	13.483	13.717	
CD (Hybrid)	**0.215**	**CD (Day)**	**0.165**	**CD (Hybrid x Day)**		**0.233**

Table.6 Effect of number of days and ripening agents on pH of different hybrids

Day	Bobby			Muskan		
	Control	CaC_2	Ethephone	Control	CaC_2	Ethephone
1	5.15	5.3	5.2	5.05	5.15	5.15
2	5.25	5.45	5.35	5.3	5.45	5.35
3	5.75	5.85	5.8	5.65	5.9	5.8
4	6.05	6.0	6.0	5.7	6.0	6.0
5	6.1	6.15	6.05	5.8	6.15	6.1

Table.7 Interaction between ripening agents and different hybrids

Hybrid	Control	CaC_2	Ethephone	Mean (Hybrid)
Bobby	5.66	5.75	5.68	5.697
Muskan	5.5	5.73	5.68	5.637
Mean (Ripening agent)	5.58	5.74	5.68	
CD (Ripening agent)	**0.053**	**CD (Hybrid)**	**0.06**	
CD (Ripening agent x hybrid)		**0.075**		

Table.8 Effect of number of days and ripening agents on fruit diameter (cm)

Day	Bobby			Muskan		
	Control	CaC_2	Ethephone	Control	CaC_2	Ethephone
1	40.95	41.65	40.55	41.95	42.45	42.25
2	40.55	41.3	40.45	41.7	42.05	41.85
3	40.35	41.15	40.15	41.2	41.65	41.6
4	40.2	40.9	39.95	40.1	41.35	41.35
5	39.95	40.85	39.5	39.9	41.1	41.25

Table.9 Interaction between hybrids and number of days on fruit diameter

Hybrid	Days after harvest					Mean (Hybrid)
	1	2	3	4	5	
Bobby	41.05	40.767	40.55	40.35	40.10	40.563
Muskan	42.217	41.867	41.483	40.933	40.75	41.45
Mean (Days)	41.633	41.317	41.017	40.642	40.425	
CD (Hybrid)	**0.343**	**CD (Day)**	**0.183**	**CD (Hybrid x Day)**		**0.259**

In case of Bobby, the increase in pH was 18.4 per cent and was 14.8 per cent for Muskan, with the passage of time (day 1 to 5). Hence, it can be said that treatment of fruits with ripening agents result in an increase in the pH value. The interaction revealed that pH was maximum for both the hybrids with calcium carbide, at par with Ethephone and statistically higher than control in both the hybrids (Table 7).

Fruit diameter

The data revealed that there was a significant difference in the fruit diameter of both the hybrids which might be due to difference in genetic makeup (Table 8). However, there was no significant effect of ripening agents on fruit diameter. There was a significant decrease in the fruit diameter with the increase in duration of treatment and the interaction effect recorded was 0.259 (Table 9).

The interaction revealed that although the fruit diameter decrease was gradual with the duration but its impact was more on Muskan than Bobby, which might be due to initial higher fruit diameter of the fruit.

This study indicated that there was no effect of using either calcium carbide or ethephone

on the fruit weight, fruit diameter, rind thickness and TSS, whereas, pH values increased in treated muskmelon fruits over the control. It can be concluded that muskmelon fruits can be ripened naturally at room temperature during the months of May-June as the day temperature exists between 40 to 45^{o} C. Hence, efforts need to be made in convincing the traders that there is no beneficial effect of treating muskmelon fruits with a banned calcium carbide because it did not affect any parameter.

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