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Effect of type of bags on chemical properties and sensory parameters of mango fruit cv. Alphonso

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Abstract
Bagging mango fruit was undertaken at Department of Horticulture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli in summer, 2015. The various treatments namely, T_1 – Newspaper bag, T_2 – Brown paper bag, T_3 – Scurting bag, T_4 – Plastic bag, T_5 – Butter paper bag, T_6 – Muslin cloth bag, T_7 – Brown paper bag with polythene coating, T_8 –Black polythene bag, T_9 Opeque colour polythene bag and T_{10}- Control (without bag) were tried in RBD with three replications. Fruits were bagged at 60 days after fruit set (i.e. egg stage). At harvest, the highest β- carotene content was observed in T_2. The reducing sugars were found highest in T_5 and the highest ascorbic acid was found in T_{10}. But as compared to the chemical properties at harvest stage, trend of chemical properties of fruits at ripe stage were found different. The reducing sugars and TSS in ripe fruit were highest in T_4. The average ascorbic acid in ripe fruit was highest in T_9, whereas the highest β- carotene content of ripe fruits was in T_1. Thus, it is concluded that different type of bags influenced chemical properties of mango fruit.

Keywords: alphonso, bagging, egg stage

Introduction
Mango (*Mangifera indica* L.) unarguably is one of the oldest and choicest tropical fruit of the world and is rightly designated as "King" of all fruits. The single cultivar "Alphonso," locally called 'Hapus' is mainly grown in the Konkan region of Maharashtra. It is known for its delicious taste, exceedingly acceptable flavour, pleasing colour, good keeping quality and excellent processing properties. It is also well known for both table and processing purposes Cheema and Dani [1]. In India, as Alphonso is mostly consumed as a table fruit, its external appearance is an important parameter. Attractive fruits fetch premium rate in the market. There are various approaches to improve external appearance of fruit. Bagging of fruit is one of the best way among these various means. Bagging protects fruits from pests, fungal infections, diseases, mechanical damage, reduces spraying of insecticides, and provides an estimate of harvestable fruits per tree. Bagging of fruits is done to prevent damage occurring due to bruises, wounds, scars also diseases, pest attack and to produce cleaner fruit skin with attractive colour. In mango, bagging also helps to prevent fruit fly attack and fungal disease incidence. Pre-harvest bagging has shown improvement in the quality of fruits. Further, in recent years the unfavourable climate is often experienced in the Konkan region of Maharashtra which spoil the external appearance of fruit. Thus bagging can be helpful under such conditions. Pre-harvest bagging possess prospectus in Alphonso mango, which is not much attempted and hence, the present study was conducted to study the effect of bagging on chemical properties of mango cv. Alphonso.

Material and Methods
The experiment was conducted in the Mango orchard of cv. Alphonso, Department of Horticulture, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M. S.) India, 415712 during 2015. Dapoli represents more or less tropical climate having average humidity 78% throughout the year. The average minimum and maximum temperature is 18.5 ^{0}C and 30.8 ^{0}C respectively with an average precipitation of 3,500 mm, distributed mainly during four months from June to September. The soil of experimental plot is red lateritic with uniform depth and good drainage conditions. Uniformly grown Alphonso mango trees were selected. The experiment was conducted in Randomized Block Design with ten treatments replicated three times with a unit of 25 fruits per treatment

per replication. Different types of bags constituted the treatments viz.: T_1: News paper bags, T_2: Brown paper bags, T_3: Scurting bags, T_4: Plastic bags, T_5: Butter paper bags, T_6: Muslin cloth bags, T_7: Brown paper bags with polythene coating, T_8: Black polythene bags, T_9: Opeque white polythene bags, T_{10}: No Bagging (control). Uniformly grown fruits at egg stage (60 days after fruit set) were selected for bagging. The size of bags was 8" x 10". Perforations were made at the bottom of bags (4mm) on all bags except for scurting and muslin cloth bags for proper ventilation required during fruit development. In case of more than two fruits in a cluster, the smaller underdeveloped, deformed fruits, spotted fruits were removed by secateur and only 1 healthy fruit was bagged. While bagging the newspaper bags, brown paper bags, scurting bags, plastic bags, butter paper bags, muslin cloth bags and brown paper coated with polythene bags were stapled properly, so that it will not fall down as well as there will not be open space for entry of insects or rain etc. For proper colour development of fruit, all bags were removed 3 days before harvesting. The mature fruits were harvested at 80 - 85 percent maturity. Fruits were ripened at ambient temperature by using traditional paddy straw as ripening material. In this method plastic crates with perforation were used. At the bottom, 2.5 cm layer of paddy straw was made on which fruit were arranged. Simultaneously, two more layers were kept on the first layer. The ripe fruits were examined for their sensory qualities. The chemical parameters like TSS, titratable acidity, ascorbic acid, reducing sugar, total sugars and β - carotene were recorded at harvest and ripe stage.

Total soluble solids (T.S.S.) were determined with the help of Hand Refractometer (Erma Japan, 0 to 32 ^{0}Brix) and value was corrected at 20 ^{0}C with the help of temperature correction chart A.O.A.C., 1975 [2]. The titratable acidity (%), reducing sugars (%), total sugars (%), Ascorbic acid (mg/100g of fruit pulp) were estimated as per the methods suggested by Ranganna [3]. β - carotene (µg/100g of pulp) were determined as per the method described by Roy [4]. The ripe fruits were examined for their sensory qualities for accessing the colour, flavour and texture. It was carried out by panel of 5 judges with 9 point Hedonic scale score Amerine *et al.* [5].

The data obtained was analysed statistically as per the method suggested by Panse and Sukhatme [6]. The standard error of mean (S.Em.) was worked out and the critical difference (C.D.) at 5 percent was calculated whenever the results were found significant.

Results and discussion

Effect of type of bags on chemical properties of fruits at harvest stage

Chemical parameters of fruits at harvest stage are showed in table no.1. The highest T.S.S. was observed in T_3 (9.77 ^{0}B) which was significantly superior over all the treatments. The least T.S.S. was seen in T_6 (7.90 ^{0}B). Higher temperature favour the conversion of starch into sugars. Reddy [7] found higher T.S.S. in covered bunches of banana than uncovered bunch. Light affects the quality of fruits Anon [8].

The highest acidity was found in T_7 (3.67%) which was at par with T_6 (3.54%) and T_9 (3.52%) and the lowest acidity was recorded in T_5 (2.23%). Changes in titrable acidity in fruits might be because of changes in metabolic activities due to modified atmosphere created by bags. Singh *et al.* [9] reported in Allahabad Safeda guava that bagged fruits were superior to non-bagged fruits for acidity.

Ascorbic acid content was highest in T_{10} (83.20 mg/100 g) which was at par with T_9 (81.60 mg/100 g). The minimum ascorbic acid was observed in T_5 (64.00 mg/100 g). Change in level of ascorbic Acid which might be because of protection of fruits from light due to bagging as well as due to modified atmosphere results in slower rate of metabolic activities. In guava, newspaper bagging maintained higher level of ascorbic acid, whereas perforated polythene and netted clothed bagging could not protect fruit. Hence the fruit bagged with these treatments lost the amount of ascorbic acid significantly along with the control Abbasi *et al.* [10]

At harvest, the estimation for reducing sugars was significant. The highest reducing sugars were found in T_5 (1.47%) which was at par with T_8 (1.46%) and T_{10} (1.44%). Reducing sugars were lowest in treatment T_2 (1.02%). The variation found for total sugars was significant. The highest total sugars were obtained in T_8 (2.94%) which was at par with T_1 (2.89%). Total sugars content was lowest in T_6 (2.26%). The increase in sugars (reducing and total) could be due to the breakdown of polysaccharides into water soluble sugars such as glucose, fructose and sucrose. In present investigation fruits bagged in black polythene bag, news paper bag, butter paper bag, plastic bag and scurting bag improved total sugar as compared to control. Hongxia *et al.* [11] concluded in Zill mango that single white layer bagging tended to produce fruit with best internal quality, which had the highest content of sucrose, glucose and fructose.

The variation found in β- Carotene was significant. The average β- carotene content of fruits was 328.80 µg/100 g of pulp. The highest β- carotene content was observed in T_2 (335.17 µg/100 g and lowest β- carotene was found in T_3 (323.11 µg/100 g). Fruit bagging had significant effect on carotenoid content of fruit in mango. Zhao *et al.* [12] studied effect of bagging on the composition of carotenoid contents in mango fruit and reported that bagging enhanced the contents of total carotenoid.

Effect of type of bags on chemical properties of fruits at ripe stage

Chemical parameters of fruits at ripe stage are presented in table no.2. The average T.S.S. content of fruit was 18.09 ^{0}B. It was highest in T_4 (19.53 ^{0}B) which was significantly superior over rest of the treatments. The lowest T.S.S. was noted in T_2 (16.17 ^{0}B). The mean acidity was 0.24 percent. It was maximum in T_4 and T_8 (0.27%) which was at par with T_9 and T_2 (0.25%) and minimum acidity was noticed in T_5 (0.20%). The ascorbic acid was highest in T_9 (62.00 mg/100 g) which was significantly superior over all other treatments. The ascorbic acid content was lowest in T_6 (52.91 mg/100 g). The reducing sugars in ripe fruit were highest in T_4 (2.36%). The reducing sugars were lowest in T_3 (1.66%). The total sugars were maximum in T_7 (9.26%) which was significantly superior over all other treatments. The total sugars were lowest in T_4 (6.26%). The mean β- carotene content of fruits was 11483.90 µg /100 g. It was highest in T_1 (12068.35 µg /100 g). The β- carotene content was lowest in T_3 (10962.53 µg /100 g).

Large number of physiological, biochemical and structural changes occurred during ripening of fruits which include the degradation of starch or other stored polysaccharides, production of sugars, synthesis of pigments and volatile compounds and the partial solubilization of cell wall Dhawan *et al.* [13] Watanawan *et al.* [14] reported that brown paper bagging had significant effect on carotenoid content of fruit in mango.

Sensory evaluation

Effect of different type of bags on sensory qualities of fruits at ripe stage is presented in table no. 3. The variation recorded for colour, flavour, texture were non-significant. In case of colour, fruits bagged with the T_1, T_2, T_3, T_5, T_6, T_7, T_8 had the fruits in the class of 'Like very much' and the T_4, T_9, T_{10} had the fruits in the class of 'Like moderately'. While comparing the sensory score of flavour and texture, all the treatments having the same class i.e. 'Like moderately'. Thus, the average sensory score for all the treated fruits including control were in the class of 'Like moderately'.

Table 1: Effect of type of bags on chemical properties of fruits at harvest stage.

Treatments	T.S.S. (^{0}B)	Acidity (%)	Ascorbic acid (mg/100 g)	Sugars		β – carotene (µg /100 g of pulp)
				Reducing sugars (%)	Total sugars (%)	
T_1 (News paper bag)	9.20± 0.10	3.07± 0.06	72.00± 0.40	1.35± 0.04	2.89± 0.03	332.21± 2.43
T_2 (Brown paper bag)	9.33± 0.06	3.38± 0.13	69.60± 1.40	1.02± 0.04	2.28± 0.02	335.17± 3.22
T_3 (Scurting bag)	9.77± 0.06	2.27± 0.07	65.60± 1.83	1.28± 0.02	2.56± 0.02	323.11± 2.16
T_4 (Polythene bag)	8.10± 0.10	3.39± 0.06	65.60± 1.22	1.37± 0.03	2.58± 0.02	331.10± 1.91
T_5 (Butter paper bag)	9.07± 0.12	2.23± 0.06	64.00± 2.20	1.47± 0.05	2.76± 0.03	325.10± 3.47
T_6 (Muslin cloth bag)	7.90± 0.10	3.54± 0.07	72.00± 0.80	1.29± 0.08	2.26± 0.10	329.91± 1.95
T_7 (Brown paper bag with polythene coating)	9.27± 0.06	3.67± 0.07	74.40± 1..51	1.18± 0.05	2.40± 0.10	323.17± 4.65
T_8 (Black Polythene Bag)	8.97± 0.06	2.59± 0.06	80.00± 1.4	1.46± 0.02	2.94± 0.04	335.05± 4.85
T_9 (Opeque colour bag)	8.50± 0.1	3.52± 0.12	81.60± 3.10	1.30± 0.01	2.27± 0.05	326.84± 2.84
T_{10} (Control)	9.33± 0.21	3.42± 0.10	83.20±	1.44± 0.03	2.48± 0.03	326.35± 1.59
Range	7.90 – 9.77	2.23 -3.67	64.00 – 83.20	1.02 – 1.47	2.26 – 2.94	323.11 – 335.17
Mean	8.94	3.11	72.80	1.32	2.54	328.80
S. Em ±	0.06	0.05	0.89	0.02	0.03	1.88
C. D. at 5%	0.18	0.14	2.65	0.06	0.09	5.60

Table 2: Effect of type of bags on chemical properties of fruits at ripe stage.

Treatments	T.S.S. (^{0}B)	Acidity (%)	Ascorbic acid (mg/100 g)	Sugars		β – carotene (µg /100 g of pulp)
				Reducing sugars (%)	Total sugars (%)	
T_1 (News paper bag)	19.33± 0.15	0.23± 0.01	57.04± 0.48	2.19± 0.08	8.38± 0.04	12068.35± 239.12
T_2 (Brown paper bag)	16.17± 0.15	0.25± 0.01	53.73± 1.02	1.90± 0.05	8.72± 0.06	11362.05± 365.35
T_3 (Scurting bag)	17.03± 0.06	0.22± 0.01	55.39± 1.02	1.66± 0.05	7.98± 0.09	10962.53± 232.49
T_4 (Polythene bag)	19.53± 0.06	0.27± 0.01	57.87± 1.43	2.36± 0.07	6.26± 0.05	11921.60± 145.28
T_5 (Butter paper bag)	16.60± 0.10	0.20± 0.01	54.56± 0.48	1.96± 0.02	7.73± 0.03	11284.30± 637.47
T_6 (Muslin cloth bag)	18.03± 0.06	0.23± 0.01	52.91± 1.02	1.89± 0.01	7.45± 0.02	11353.64± 111.47
T_7 (Brown paper bag with polythene coating)	18.53± 0.06	0.24± 0.02	54.56± 1.48	1.77± 0.02	9.26± 0.06	11227.79± 347.79
T_8 (Black Polythene Bag)	18.17± 0.15	0.27± 0.01	57.04± 0.48	2.10± 0.07	8.08± 0.07	12023.55± 142.20
T_9 (Opeque colour bag)	19.10± 0.1	0.25± 0.007	62.00± 0.48	2.18± 0.08	8.09± 0.07	11355.17± 171.6
T_{10} (Control)	18.40± 0.1	0.21± 0.01	56.21± 0.75	2.01± 0.01	8.48± 0.04	11280.08± 248.00
Range	16.17–19.53	0.20 – 0.27	52.91 –62.00	1.66 – 2.36	6.26 – 9.26	10962.53 –12068.35
Mean	18.09	0.24	56.13	2.00	8.04	11483.90
S. Em ±	0.06	0.01	0.51	0.03	0.03	168.01
C. D. at 5%	0.17	0.02	1.53	0.08	0.10	499.19

Table 3: Effect of bagging on sensory evaluation of ripe fruits in mango Cv. Alphonso.

Treatments	Sensory score for			Average score
	Colour	Flavour	Texture	
T_1 (News paper bag)	8.33± 0.58	7.67± 0.58	7.67± 0.58	7.89± 0.38
T_2 (Brown paper bag)	8.00± 0.00	7.33± 0.58	7.67± 0.58	7.67± 0.33
T_3 (Scurting bag)	8.27± 0.64	7.67± 0.58	7.67± 0.58	7.87± 0.35
T_4 (Polythene bag)	7.93± 0.12	7.67± 0.58	7.33± 0.58	7.64± 0.30
T_5 (Butter paper bag)	8.27± 0.64	7.33± 0.58	7.33± 0.58	7.64± 0.54
T_6 (Muslin cloth bag)	8.00± 0.00	7.33± 0.58	7.33± 0.58	7.56± 0.38
T_7 (Brown paper bag with polythene coating)	8.00± 0.00	7.67± 0.58	7.27± 0.46	7.65± 0.37
T_8 (Black Polythene Bag)	8.30± 0.61	7.67± 0.58	7.67± 0.58	7.88± 0.37
T_9 (Opeque colour bag)	7.93± 0.11	7.00± 1.00	7.33± 0.58	7.42± 0.47
T_{10} (Control)	7.63± 0.55	7.00± 1.00	7.27± 0.46	7.30± 0.31
Range	7.63– 8.33	7.00 – 7.67	7.27 – 7.67	7.30 – 7.89
Mean	8.07	7.43	7.45	7.65
S. Em ±	0.19	0.27	0.17	0.15
C. D. at 5%	NS	NS	NS	NS

Conclusion

The results indicate that preharvest bagging by using various types of bags influenced the chemical composition of fruits at ripe stage over the non-bagged fruits. However the trend was not consistent. The T.S.S. and reducing sugars were improved by plastic bags whereas opeque coloured bags enriched ascorbic acid of the fruits. All bags improved sensory quality over non-bagged fruits in mango Cv. Alphonso.

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