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RESEARCH PAPER

Preservation of Snow Ball Tender Coconut

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ABSTRACT

The snow ball of tender coconut of variety *Banavali* was used for the study. The snow ball tender coconut (6-7 month maturity) of *Banavali* verity scooped out from the shell. The snow ball tender coconuts were packed in the different packaging material i.e. polypropylene bags, PVC film and Aluminum film. The packed snow ball tender coconut were exposed for the storage conditions i.e. at ambient storage condition (24±2 °C) The storability of the snow ball tender coconut stored at ambient condition 3 days duration i.e. 0, 3, 6 and 9 days. The sample without packaging was kept as a control sample. The snow ball tender coconut was observed for its Firmness and weight loss for 0, 3, 6 and 9 days. The quality analysis of the snow ball tender coconut water was analyzed for its pH, TSS, Acidity, Reducing sugar and Non-Reducing sugars for 0,3,6 and 9 days.

Keywords: Snow ball tender coconut, polypropylene bags, PVC film and Aluminum film, storage, coconut water

The world production of tender coconut is around 54,716,444 Nuts (FAO, 2010). India is the third largest producer of coconut in the world and its share in the world production moved up from 12% to 15%. The State of Kerala, which accounts for about 1% of the total land area of India, contributes to about 57% of the coconut area and 47% of the coconut production. The other southern states, Tamil Nadu, Karnataka and Andhra Pradesh together account for 34% of the area under coconut but contribute 44% of the production (George *et al*. 1991). Average yields in the three major coconut states, Kerala, Karnataka and Tamil Nadu are about 33, 44 and 54 nuts per palm per year respectively, (Anonymous).

In Maharashtra the total area covered by coconut plantation was 22259 hectors and the production 1195 lakh nuts, and productivity is 5369 nuts/ha. The highest productivity in Thane districts is 9702 nuts/ha, the Sindhudurg is the top most one 531 lakh nut in the production of coconut in Maharashtra (Anonymous).

Coconut (*Cocos nucifera L.)* is marketed at two stages of development, at an immature stage, the fruit (water coconut) contains mainly water and a little jelly-like meat instead of the hard white flesh (meat - endosperm) found in mature coconuts. The tender coconut at this stage contains large amounts of sweet fluid called coconut water and has very tender

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developing layer of white meat within. The water of tender coconut, is the most nutritious wholesome beverage which helps the people of the tropics to fight the hot and humid climate.

The brown husked coconut is rusty brown and covered with hairy brown fibers, the thick fibrous husk of the coconut encases an inner shell. Coconut meat is used for preparing variety of spicy as well as sweet dishes. The husked coconut is also used among the Hindu community of India as a offering to the God (Anonymous).

The tender coconut are beneficial to health. Its milk is free from cholesterol. It is easy for digestibility and absorbability. It can be an ideal energy source in baby foods. It contains Vitamin E (Anonymous). The coconut water is reach source of nutrition, there are two major types of coconut i.e. young coconut and other one is mature coconut (Anonymous).

The storage of the young tender coconut water, it was observed that it can remain fresh and safe for 3 weeks stored as (13 to15) °C and 70% RH (reefer containers). The minimum processing consists of dipping partially husked nuts in a solution of 0.5% citric acid and 0.5% of potassium metabisulphite for 3 min. The final product, wrapped with polypropylene cling film, can be stored for up to 24 days at (5 to 7) °C. Coconut water (CW), also called coconut juice is a sweet refreshing The average weight young coconut of 565g at the age 6 month. The water content of tender coconut is 94.18g/100g, dry mater is 5.01g/100g, protein, fat, ash are respectively 0.12g, 0.07g, 0.87g of per 100g. The total sugar are available i.e. 5.23g/100g. The sugar in tender coconut comprises sucrose, glucose, fructose are 0.06g, 2.61g, and 2.55g per 100g of coconut water drink taken directly from the inner part of coconut fruits. It differs from coconut milk, which is the oily white liquid extracted from the grated fresh kernel. The coconut water consumed as a beverage usually comes from immature coconut fruits. Due to its unique characteristics, coconut water is considered as a natural functional drink. Its sugar content and mineral composition make it an ideal rehydrating and refreshing drink after physical exercise (Parades *et al.* 2012).

In snow ball tender coconut the nuts are harvested at 6-7 month of its maturity and harvested the tender coconuts and husk and hard shell are removed and the coconut ball with water is being eater. The edible part of nut with water is separated from the tender coconut. The snow ball tender coconut has various advantages after the partially husked tender coconut. The transportation cost for the nuts be reduced for larger distances. As the snow ball is edible it can be consumed as such after drinking the water inside the ball. It can be a value addition to the tender nut of 6-7 months maturity and will give better return to the farmers/entrepreneurs who are engaged in the entrepreneurship of tender coconut. The snow ball tender coconuts and water can be used in variety of food preparation like, sweet making, chutney making. The snow ball water can be used as health drink, vinegar preparation etc. (Parades *et al.* 2012).

Tender coconuts after removing from the tree can be kept for 15 days without spoilage in ambient conditions. After that, fermentation takes place and coconut water becomes unfit for consumption (Parades *et al.* 2012).

Snow ball tender coconut need to be preserved from moisture loss, from dust, dirt and foreign material when it is kept openly. It is also necessary to increase the shelf life of snow ball tender coconut. Good quality packaging material for packaging of the snow ball tender coconut not only increases the shelf life of nuts but also its marketability. Based on the above information current project was undertaken with the following objectives**.** To study the effect of various packaging material on storability of snow ball tender coconut. And to study the quality of stored snow ball tender coconut water and nut.

MATERIALS AND METHODS

Snow Ball Tender Coconut

Tender coconut of *Banawali* variety was procured from the garden of Department of Horticulture, Dr. B.S.K.K.V of Dapoli. Tender coconut of 6-7 months maturity was used for the study. By using the coconut

dehusker the husk from the tender coconut was removed. The outer hard coat (shell) of the snow ball of the tender nut was given a two cutting slots using a wood cutting machine (with S.S. cutting blade) without damaging the inner soft part of snow ball tender coconut. The snowball of the tender coconut was scooped with the help of a plastic knife. Fig. 1 (a) shows the Tender coconut of *Banawali* variety and Fig. 1(b) shows Snow Ball Tender Coconut of *Banawali* variety.

Packaging of snow ball tender coconut

The scooped snowball was packed by using various packaging materials like polypropylene bags, PVC film and Aluminum film.

(a) Polypropylene bags

Polypropylene bags also known as polypropylene is a thermoplastic polymer used in a wide variety of applications including packaging and labeling. The snow ball tender coconut was packed in polypropylene bags of capacity 500g. The size of the bag was 27×18 cm. The thickness of polypropylene bags is 100(μ). Fig. 2(a) shows the snow ball tender coconut stored in polypropylene bags.

(b) PVC film

PVC (Polyvinyl chloride) ceiling film was used for the wrapping of the snow ball tender coconut with the help of wrapping machine. Fig. 2(a) shows the PVC film roll used for packaging of snow ball tender coconut. Thickness of the PVC ceiling film was 60 μ, the size of the film was 30×15 cm. Fig. 2(b) shows the snow ball tender coconut was packed in PVC film.

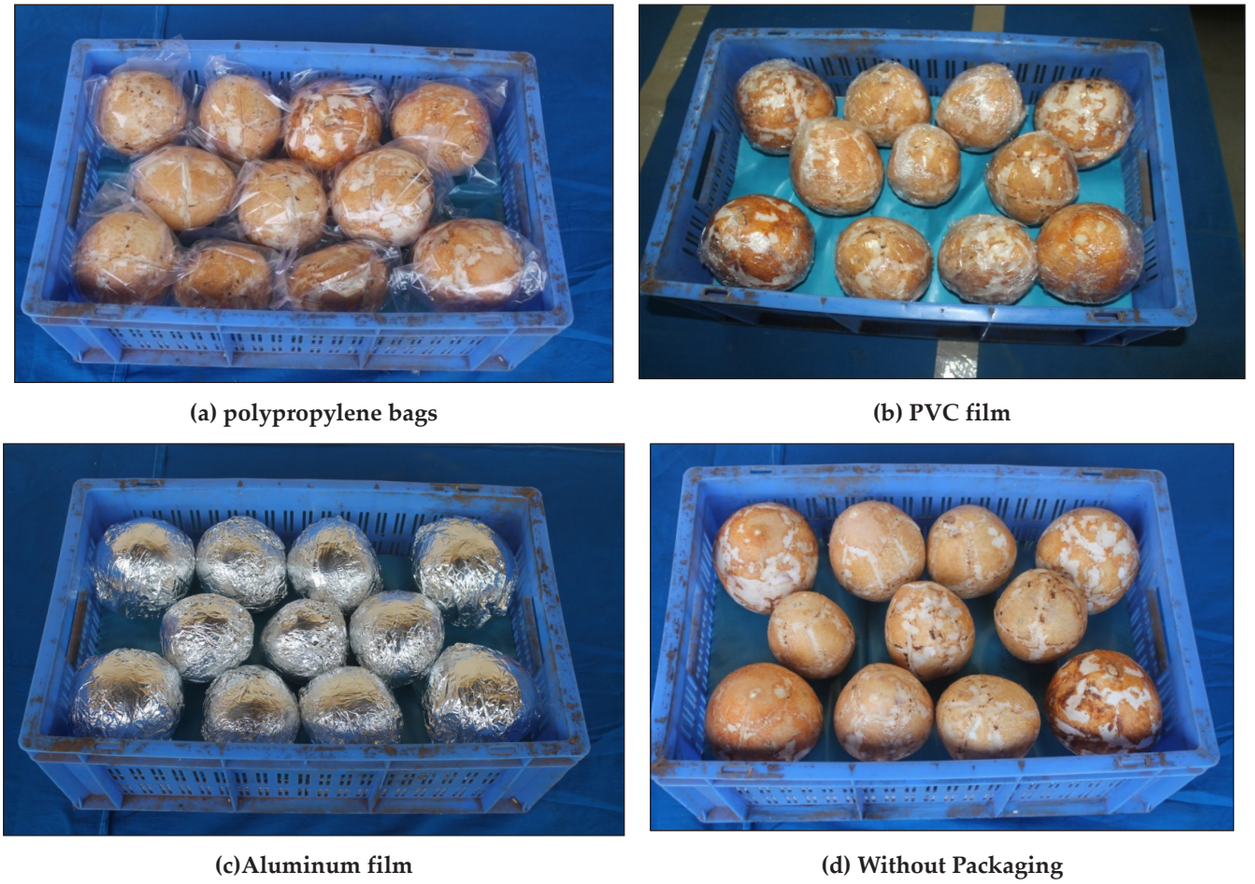
(c) Aluminum film

Aluminum is used as soft-package for food material. Aluminium film of 110(μ) was used as a wrapping material for snow ball tender coconut with the help of wrapping machine. Fig. 2.(c) shows the Aluminium film roll used for packaging of snow ball tender coconut. Thickness of the PVC ceiling film was 110 μm, the size of the film was 30×20 cm. It has high strength, good adhesion of aluminum layer.

Storage of snow ball tender coconut

(a) **(b)**

Fig. 1: (a) Tender coconut of *Banawali* Variety **(b)** Snow Ball Tender Coconut of *Banawali* variety



(a) polypropylene bags **(b) PVC film**

(c)Aluminum film **(d) Without Packaging**

Fig. 2: Snow ball tender coconut stored at ambient condition in **(a)** polypropylene bags; **(b)** PVC film and **(c)** Aluminum film **(d)** Without Packaging (W.P.)

The snow ball of tender coconut of variety *Banavali* was used for the study. The snow ball tender coconut (6-7 month maturity) of Banavali verity scooped out as per the procedure discussed in the earlier section 2.1. The snow ball tender coconuts were packed in the different packaging material i.e. polypropylene bags, PVC film and Aluminum film (as described in Section 2.2.). The packed snow ball tender coconut was exposed for the storage conditions i.e. at ambient storage condition (24±2 °C) and at Cold storage condition (13±1 °C) (Fig.2(a)-(d)). The storability of the snow ball tender coconut stored at ambient condition and cold storage condition was accessed for 3 days duration i.e. 0, 3, 6 and 9 days. The sample without packaging was kept as a control sample. The snow ball tender coconut was observed for its Firmness and weight loss for 0, 3, 6 and 9 days. The quality analysis of the snow ball tender coconut water was analyzed for its pH, TSS, Acidity, Reducing sugar and Non- Reducing sugars for 0,3,6 and 9 days.

Quality Analysis of Snow Ball Tender Coconut:

There are different methods are use for the analysis of tender coconut water. That method is as follows:

(a) Weight loss

A simple technique was used to measured weight loss of snow ball of tender coconut. The snow ball tender coconut packed at different material i.e. (a) polypropylene bags; (b) PVC film and (c) Aluminum

film (d) Without Packaging and stored at ambient and cold storage conditions. The weight at each storage duration i.e. 0, 3, 6 and 9 days was recorded. The change in weight as compare with initial weight was recorded as a weight loss.

(b) Firmness

The firmness of snow ball tender coconut was measured using QTS Texture Analyzer. Texture analyzer was made by M/s. Brookfield Engineering Labs, Inc, USA. The above mentioned snow ball tender coconut were exposed to Compression test with probe No. TA5/100 and pretest speed was 0.5 mm/s, compression depth was 5 mm, and trigger load was 20 g. The equipment after setting up the test values, gives the values of Firmness/hardness (g) of snow ball tender coconut.

Quality Analysis of Snow Ball Tender Coconut water

(a) pH

The pH of tender coconut water was measured by using digital pH meter. The pH meter was calibrated by using buffer solution having pH 7.0. The probe was dipped in a tender coconut water the equipment gives the direct reading of the pH. Three replications were carried out each treatment.

(b) TSS

The total soluble solids content of tender coconut water was measured by using refractometer (Make: Atago; Japan Model). The prism of the refractometer was cleaned with the help of distilled water and tissue paper. The distilled water was used as the TSS value of distilled water is zero and is known. This was used as standard for calibration. The snow ball tender coconut water of 2ml was put up on the prismatic shape cavity and placed lid. After pressing a start button, with in a 5 sec. the TSS of the snow ball tender coconut water was measured and shown on the display. This test was repeated for three times.

(c) Acidity

Acidity was calculated by using titration method (Ranganna, 1986). 10 ml of tender coconut water sample was taken. 20 ml distilled water was added to it. Then 2-3 drops of phenolphthalein indicator was added to it. The solution was titrated with 0.1 N NaOH. The end point is feint pink colour. Acidity was calculated by using equation,

(d) Reducing Sugar

Reducing sugar was estimated by Fehling's method (Ranganna, 1986). The process was carried out in three steps. In first part, 5 ml of tender coconut water sample was added with 20 ml distilled water. 2-3 drops of phenolphthalein indicator was added to it. This sample solution was titrated with 1 N NaOH. The end point was feint pink colour. It was filtered after addition of lead acetate and potassium oxalate solution. In second part, Fehling solution A, B and distilled water were taken in proportion 1:1:1 in a conical flask. In the third part, titration of first part solution against second part solutions was carried out by using methylene blue indicator in boiling condition. Titration was continued until the end point of brick red colour appears. Reducing sugar was calculated by using formula:

Total Acid, % =

$$\frac{\text{B.R.} \times \text{Normality} \times \text{Vol. made up} \times \text{equivalent wt.of acid} \times 100}{\text{Vol.of sample taken for estimation} \times \text{wt.of sample} \times 1000}$$

(e) Non reducing sugar

Non reducing sugar was determined as per the Ranganna, 1986. In this method, part one solution of reducing sugar was used. 50 ml of this solution was neutralized with concentrated 20 N NaOH after overnight keeping with 1:1 HCL. By making 100 ml volume with distilled water, this solution was titrated with part two solutions i.e. first part and second part. In the third part same procedure was followed as discussed in reducing sugar. Total sugar of snow ball tender coconut water was calculated by using equation,

Total Sugar, % =

$$\frac{\text{mg of invert sugar} \times \text{Dilution} \times 100}{\text{Titration} \times \text{Wt. or volume of sample} \times 100}$$

And non reducing sugar was calculated by using equation:

Non Reducing Sugar, % = Total sugar, % × 0.95

RESULTS AND DISCUSSION

Effect of packaging material and storage duration on weight loss of snow ball tender coconut stored at varied condition (Ambient and Cold Storage condition)

Fig. 3 (a) shows the effect of packaging materials and storage duration on weight loss of snow ball tender coconut stored at an ambient condition. The weight loss of the snow ball tender coconut stored at an ambient condition was increases as the storage period increase from 0-8 days. The trends shows that increase in weight loss of snow ball tender coconut was higher in without packaging compare with aluminum, PVC film and Polypropylene packaging material.

Fig. 3 (b) shows the effect of packaging materials and storage duration on weight loss of snow ball tender coconut stored at cold storage condition. The weight loss of the snow ball tender coconut stored at cold storage condition was increase as the storage period increase from 0-8 days. The trends shows that increase in weight loss of snow ball tender coconut water was higher in aluminum and polypropylene packaging material as compare with the PVC film packaging material and without packaging.

Effect of packaging material and storage duration on hardness of snow ball tender coconut stored at varied condition (Ambient and Cold Storage condition)

Fig. 4(a) shows the effect of packaging materials and storage duration on hardness of snow ball tender coconut stored at an ambient temperature. The hardness of the snow ball tender coconut stored at an ambient temperature varies as the storage period increases from 0-6 days. Similar trends were observed for all the packaging materials and the without packaging also. The hardness of snow ball tender coconut water increases in PVC film and polypropylene packaging material from storage period 3-6 days as compare to aluminum packaging material and without packaging from storage period 3-6 days.

Fig. 4.(b) shows the effect of packaging materials and storage duration on hardness of snow ball tender coconut stored at cold storage condition. The hardness of the snow ball tender coconut stored at cold storage condition varies as the storage period increase from 0-6 days. Similar trends were observed for all the packaging materials and the without packaging also. The hardness of snow ball tender coconut water was higher in aluminum and PVC film from storage period 0-3 days compared with polypropylene material and without packaging from

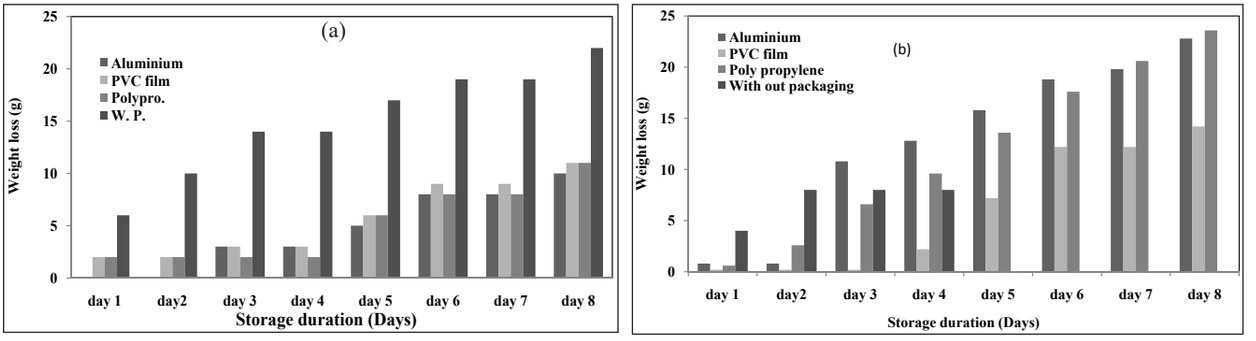


Fig. 3: Effect of various packaging materials and storage duration on the weight loss (g) of Snow ball tender coconut stored in **(a)** ambient temperature; **(b)** cold storage

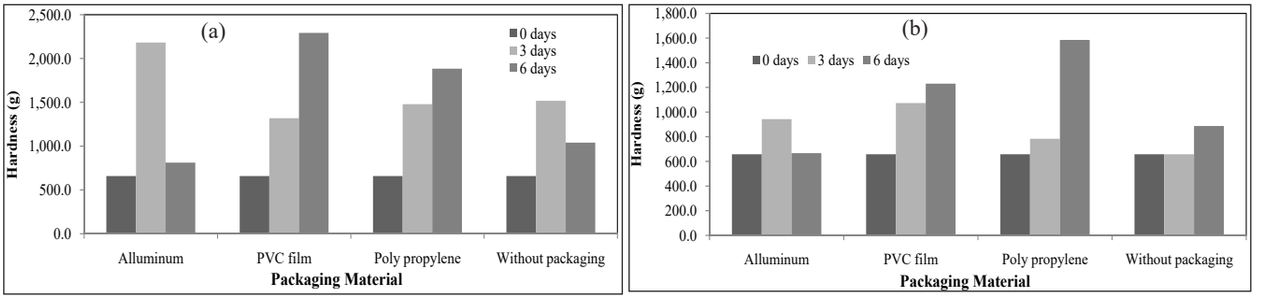


Fig. 4: Effect of various packaging materials and storage durations on Hardness (g) of snow ball tender coconut water stored at varied condition **(a)** ambient temperature; **(b)** cold storage

storage period 0-3 days.

Effect of packaging material and storage duration on pH of snow ball tender coconut water the snow ball stored at varied condition (Ambient and Cold Storage condition)

Fig. 5(a) shows the effect of packaging material and storage duration on pH of snow ball tender coconut water stored at an ambient temperature. The pH of the snow ball tender coconut water stored at an ambient temperature decrease as the storage period increases from 0-6 days. Similar trend were observed for all the packaging materials and the without packaging also. The pH of snow ball tender coconut water decrease from 5.25 to 4.30. The pH of snow ball tender coconut water decrease from 5.25 to 4.77; 5.25 to 4.67; 5.25 to 4.30 and 5.25 to 4.8 for aluminum, PVC film, polypropylene and without packaging respectively. Trend shows that decrease in pH of snow ball tender coconut water was higher from storage period 3-6 days as compare with 0-3 days.

Effect of packaging material and storage duration on TSS of snow ball tender coconut water the snow ball stored at varied condition (Ambient and Cold Storage condition)

Fig. 6(a) shows the effect of packaging material and storage duration on TSS of snow ball tender coconut water stored at an ambient temperature. The TSS of the snow ball tender coconut water stored at an ambient temperature increases as the storage period increases from 0-6 days. Similar trends were observed for all the packaging materials and the without packaging also. The TSS of snow ball tender coconut water increases from 4.60 to 5.26 ^{0}B. The TSS of snow ball tender coconut water increases from 4.60 to 5.22 ^{0}B; 4.60 to 5.26 ^{0}B; 4.60 to 4.98 ^{0}B and 4.60 to 5.19 ^{0}B for aluminum, PVC film, polypropylene and without packaging respectively. Trend shows that increases in TSS of snow ball tender coconut water was higher from storage period 0-3 days as compared with 3-6 days for Aluminum, PVC film, and without packaging. However the TSS for coconut water packed in polypropylene the changes are more from 3 to 6 days.

Fig. 6(b) shows the effect of packaging material and storage duration on TSS of snow ball tender coconut water stored at cold storage condition. The TSS of the snow ball tender coconut water stored at cold storage condition increases as the storage period increases from 0-8 days. Similar trends were observed for all the packaging materials and without packaging also. The TSS of snow ball tender coconut water increases from 4.82 to 5.55 ^{0}B during storage period increases. The TSS of snow ball tender coconut water increases from 4.82 to 5.37 ^{0}B; 4.82 to 5.55 ^{0}B; 4.82 to 5.54 ^{0}B and 4.82 to 5.52 ^{0}B for aluminum, PVC film, polypropylene and without packaging respectively. Trend shows that increases in TSS of snow ball tender coconut water was higher from storage period 3-8 days as compare with 0-3 days.

3.5 Effect of packaging material and storage duration on acidity of snow ball tender coconut water the

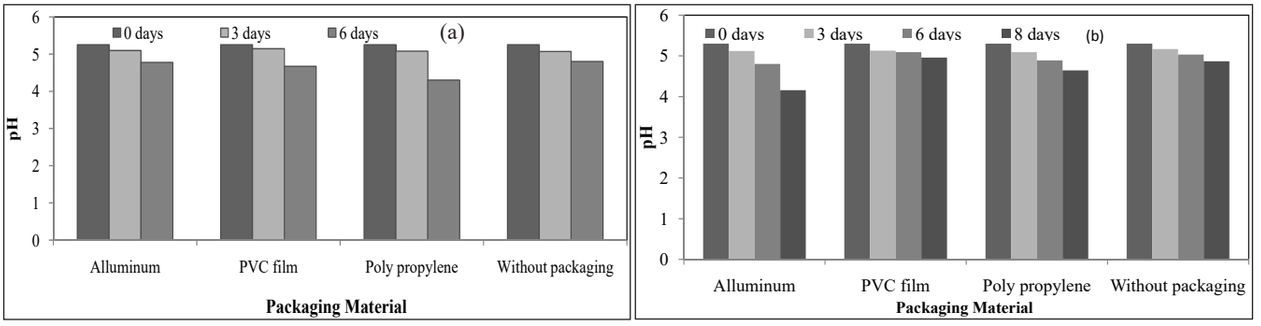


Fig. 5: Effect of various packaging materials and storage durations on pH of snow ball tender coconut water stored at varied condition **(a)** ambient temperature; **(b)** cold storage

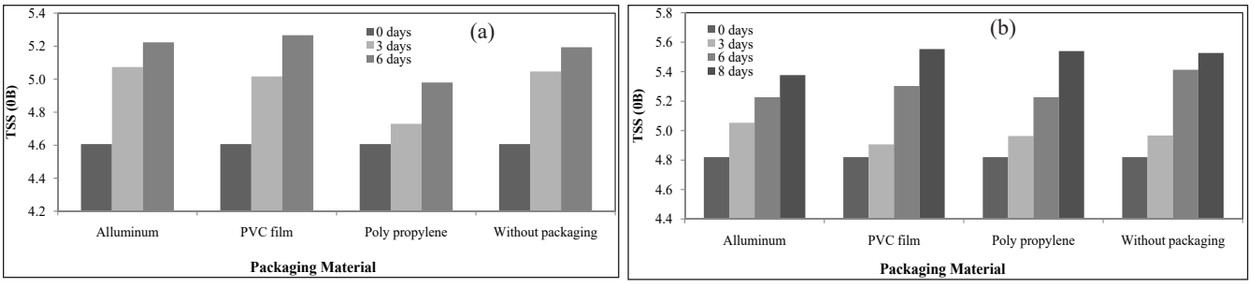


Fig. 6: Effect of various packaging materials and storage durations on TSS of snow ball tender coconut water stored at varied condition **(a)** ambient temperature; **(b)** cold storage

snow ball stored at varied condition (Ambient and Cold Storage condition).

Fig. 7 (a) shows the effect of packaging material and storage duration on acidity of snow ball tender coconut water stored at an ambient temperature. The acidity of the snow ball tender coconut water stored at an ambient temperature increases as the storage period increases from 0-6 days. Similar trends were observed for all the packaging materials and the without packaging also. The acidity of snow ball tender coconut water increases from 3.53 to 5.92%. The acidity of snow ball tender coconut water increases from 3.53 to 4.79%; 3.53 to5.11%; 3.53 to 5.92% and 3.53 to 4.93% for aluminum, PVC film, polypropylene and without packaging respectively. Trend shows that increases in acidity of snow ball tender coconut water was higher in polypropylene as compare to the other three packaging material. The acidity of snow ball tender coconut water was higher from storage period 3-6 days as compare with 0-3 days in polypropylene.

Fig. 7(b) shows the effect of packaging material and storage duration on acidity of snow ball tender coconut water stored at cold storage condition. The acidity of the snow ball tender coconut water stored at cold storage condition increases as the storage period increases from 0-8 days. Similar trends were observed for all the packaging materials and without packaging also. The acidity of snow ball tender coconut water increases from 3.53 to 4.88%. The acidity of snow ball tender coconut water increases from 3.53 to 4.72%; 3.53 to 4.58%; 3.53 to 4.58% and 3.53 to 5.01% for aluminum, PVC film, polypropylene and without packaging respectively.

3.6 Effect of packaging material and storage duration on reducing sugar of snow ball tender coconut water

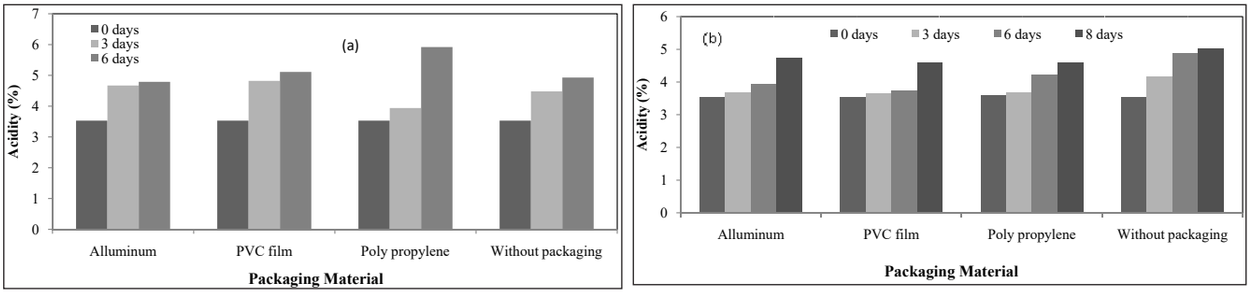


Fig. 7: Effect of various packaging materials and storage durations on Acidity of snow ball tender coconut water stored at varied condition **(a)** ambient temperature; **(b)** cold storage

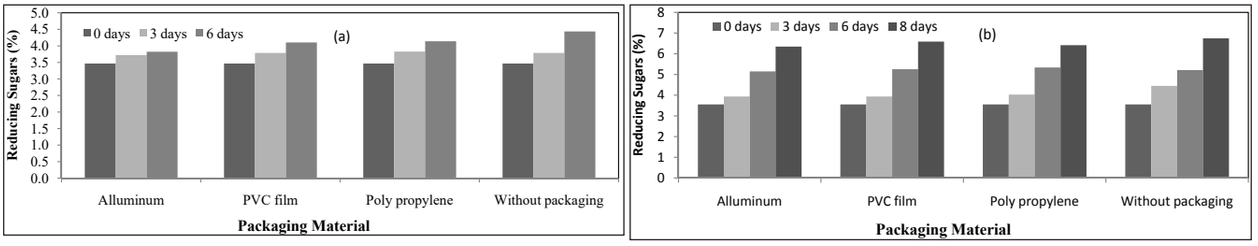


Fig. 8: Effect of various packaging materials and storage durations on Reducing Sugars of snow ball tender coconut water stored at varied condition **(a)** ambient temperature; **(b)** cold storage

the snow ball stored at varied condition (Ambient and Cold Storage condition).

Fig. 8 (a) shows the effect of packaging materials and storage duration on reducing sugar of snow ball tender coconut water stored at an ambient temperature. The reducing sugar of the snow ball tender coconut water stored at an ambient temperature increases as the storage period increases from 0-6 days. Similar trends were observed for all the packaging materials and without packaging also. The reducing sugar of snow ball tender coconut water increases from 3.46 to 4.43%. The reducing sugar of snow ball tender coconut water increases from 3.46 to 3.82%; 3.46 to 4.10%; 3.46 to 4.14% and 3.46 to 4.43% for aluminum, PVC film, polypropylene and without packaging respectively. Trend shows that increases in reducing sugar of snow ball tender coconut water was higher from storage period 3-6 days as compared with 0-3 days for PVC film, polypropylene and without packaging.

Fig. 8 (b) shows the effect of packaging material and storage duration on reducing sugar of snow ball tender coconut water stored at cold storage condition. The reducing sugar of the snow ball tender coconut water stored at cold storage condition increase as the storage period increases from 0-8 days. Similar trends were observed for all the packaging materials and without packaging also. The reducing sugar of snow ball tender coconut water increases from 3.55 to 6.74%. The reducing sugar of snow ball tender coconut water increase from 3.55 to 6.34%; 3.55 to 6.59%; 3.55 to 6.41% and 3.55 to 6.74% for aluminum, PVC film, polypropylene and without packaging respectively. Trends shows that increase in reducing sugar of snow ball tender coconut water was higher from storage period 3-8 days as compare with 0-3 days.

Effect of packaging material and storage duration on non-reducing sugar of snow ball tender coconut water the snow ball stored at varied condition (Ambient and

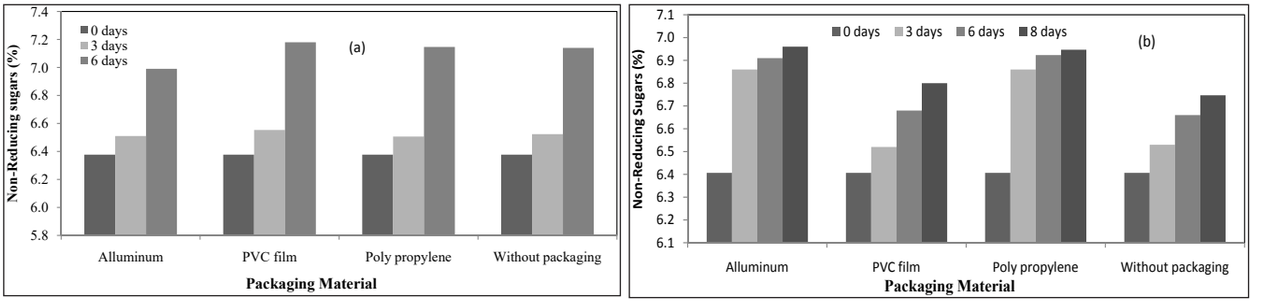


Fig. 9: Effect of various packaging materials and storage durations on Non-Reducing Sugars of snow ball tender coconut water stored at varied condition **(a)** ambient temperature; **(b)** cold storage

Cold Storage condition)

Fig. 9(a) shows the effect of packaging materials and storage duration on non-reducing sugar of snow ball tender coconut water stored at an ambient temperature. The non-reducing sugar of the snow ball tender coconut water stored at an ambient temperature increases as the storage period increases from 0-6 days. Similar trends were observed for all the packaging materials and the without packaging also. The non-reducing sugar of snow ball tender coconut water increase from 6.37 to 7.18%. The non-reducing sugar of snow ball tender coconut water increase from 6.37 to 6.99%; 6.37 to 7.18%; 6.37 to 7.14% and 6.37 to 7.14% for aluminum, PVC film, polypropylene and without packaging respectively. Trend shows that increases in non-reducing sugar of snow ball tender coconut water was higher from storage period 3-6 days as compare with 0-3 days.

Fig. 9(b) shows the effect of packaging material and storage duration on non-reducing sugar of snow ball tender coconut water stored at cold storage condition. The non-reducing sugar of the snow ball tender coconut water stored at cold storage condition increases as the storage period increases from 0-8 days. Similar trends were observed for all the packaging materials and without packaging also. The non-reducing sugar of snow ball tender coconut water increase from 6.40 to 6.96%. The non- reducing sugar of snow ball tender coconut water increase from 6.40 to 6.96%; 6.40 to 6.8%; 6.40 to 6.94% and 6.40 to 6.74% for aluminum, PVC film, polypropylene and without packaging respectively. Trend shows that increases in non-reducing sugar of snow ball tender coconut water was higher in aluminum and polypropylene material from storage period 0-3 days as compare with PVC film and without packaging material from storage period 0-3 days.

CONCLUSION

Following conclusions can be drawn from the above study:

1. Snow ball tender coconut packed in PVC cling film packaging material could be stored up to 6 days in cold storage (13+1°C) with better retention of pH, acidity, TSS, reducing sugars non-reducing sugars and weight.
2. Snow ball tender packed in PVC cling film packaging material could be stored up to 3 days in ambient storage (24+2°C) with better retention of pH, acidity, TSS, reducing sugars, non-reducing sugars and weight.

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