

Influence of Packaging Material on Physico-Chemical and Sensory Quality of Cucumber under Ambient and Refrigeration Temperatures

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Abstract:

The experiment was conducted to observe the effect of wrapping materials on physico-chemical and sensory quality of cucumber under ambient and refrigeration temperatures. A series of experiments were conducted in the Laboratory, Institute of Food Sciences and Technology, Sindh Agriculture University Tandojam. The experiment was conducted in a completely randomized design with three replications. The treatments included two factors (1. ambient temperature and 2. refrigeration temperature) and four wrapping materials: (i) control, (ii) grease free paper, (iii) news paper and (iv) polyethylene bags. Significant results were observed in packaging materials (newspaper and polyethylene bags) significantly enhanced the weight, length, diameter, TSS, pH, Total acidity, color, taste, appearance and overall acceptability of cucumber fruit under ambient and refrigeration temperature.

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Key words: Shelf life, storage, physico-chemical, packaging materials, temperatures.

1. INTRODUCTION:

Cucumber (*Cucumis sativus*), belongs to family Cucurbitaceae. It is now cultivated in the tropics and subtropics of the world and is popular vegetable crop. (Wikipedia,2014). At the present time, many tremendous market supplies uses polyethylene bags to wrap the cucumber accordingly to their weight, to preserve them in good form in addition in when it reaches to the consumer should be in fresh and wholesome form. Packaging materials have direct contact to the packaging qualities of cucumber (Diagno *et al.*, 2013). Cucumber is eaten as fresh or raw (Funamoto *et al.*, 2002). After picking cucumber loss their quality gradually owing to the cell destruction and color variations cucumbers and its shelf life is limited to 2-3 days devoid of packaging changes in peel color of cucumber fruit as the enzymatic process and effect of temperature. By use of different types of packaging shelf life of cucumber can be prolonged (Deell *et al.*, 2000). Packaging can markedly control physiological deterioration and reducing weight loss. Packing can create modified gas atmospheres around the product which inhibit respiration. Sealing of cucumber in polyethylene film packages extended the length of time until ripening (Hobson, 2002).Commercially cucumbers retained at different temperature for storage at refrigeration or cold storage (16-20C) and at room temperature of (28-30⁰C) therefore, the fruit are enfolded into different low density polyethylene films which reduces the shrinkage of fruits and also reduces fruit weight loss. Use of packages films maintain fruits quality attributes. In room temperature cucumber can decrease their shelf life about 10-12 days. Picking of cucumbers were started when they are physiologically developed for this sometime usually growers

use waxing treatment to control rate of transpiration and evaporation which reduces metabolic activities which takes place very rapidly (Kader, 2003). Shelf life of cucumber can be improved by storage them whole and unpeeled in plastic bags in the vegetables drawer in the refrigerator. Cucumbers fruit are more nutritious they contain different types of nutrient such as vitamin k, minerals. They are also a very good source of the panthenic acid. They are also a good source of potassium, copper, manganese, phosphorus, vitamin B1magnesium, vitamin C biolinand. They also contains important health promoting mineral silica (Shetty *et al.*, 2005).

2. MATERIALS AND METHODS:

The fresh cucumbers were randomly collected from local market of Tandojam. The samples were wrapped in different packing materials and stored at ambient and refrigeration temperatures (12°C). To observe the effect of wrapping materials on physico-chemical and sensory quality of cucumber changes at ambient and refrigeration temperatures. A series of experiments were conducted in the Laboratory, Institute of Food Sciences and Technology, Sindh Agriculture University Tandojam. The experiment was conducted in a completely randomized design with three replications. The treatments included two factors (1. Ambient temperature and 2. Refrigeration temperature) and four wrapping materials: (i) Control), (ii) Grease free paper, (iii) Newspaper and (iv) Polyethylene bags.

2. PHYSICAL ANALYSIS

2.1. Fresh weight of cucumber (g): Initial weight of cucumber was recorded on the digital weighing machine.

2.2. Length of cucumber (cm): Length of cucumber was measured by using Vernier caliper.

2.3. Diameter of cucumber (cm): Diameter of cucumber was examined by using Vernier caliper.

2.4. Chemical analysis: The samples were analyzed for different chemical parameters as per the procedures and methods given below.

2.5. Moisture content (%):The moisture content of samples was determined by using the procedure described in AOAC (2000), method No.44-15A. Two gram sample was weighed and also weighed the empty moisture dish .Sample was placed in oven at 130c for an hour. After that removed the sample from oven and placed in desiccator for cooling about 25minutes and weighed the sample. Moisture %age was calculated by using the following formula:

$$\text{Moisture \%} = \frac{\text{Initial wt} - \text{final wt}}{\text{sample wt}} \times 100$$

2.6. Ash content (%): The ash content of samples was determined by the procedure as described by AOAC (2000), method No.08-01. Washed and clean crucibles were dried in hot air oven at 105c for 60 minutes then weighed the empty crucibles (W_1).A well mixed sample of 3 grams were taken into crucibles as W_2 . Crucibles were placed in muffle furnace at 550c for 16 hours. Afterward crucibles were cooled in desiccator and weighed as W_3 . The following formula was used to calculate the ash content:

$$\text{Ash \%} = \frac{W_3 - W_1}{W_2} \times 100$$

2.7. Total soluble solids: The lactose content was determined by subtracting the sum of percent of fat, protein and ash content from that of total solids content of cucumber.

2.8. pH: pH value of samples were examined according the method as reported by (Ockerman,1985), sample (10g) homogenized in distilled water (90 ml) was transferred into the beaker and electrode along with temperature probe was inserted to sample. The constant reading appeared on pH meter base was noted and recorded as pH value of cucumber.

2.9. Total acidity (%): Acidity percentage was determined according to the method as described by Association of Official Analytical Chemists (AOAC, 2000). In brief 9 ml sample of each cucumber was taken in a conical flask (each in duplicate batches), and 3 drops of phenolphthalein (Indicator) was added. Thereafter, it was titrated with N/10 NaOH solution using titration kit. The volume of alkali used was noted on the burette and calculation was made by putting it in following formula:

$$\text{Titrateable acidity \%} = \frac{\text{Quantity of N/10 NaOH used} \times 0.009}{\text{Volume of cucumber sample used}} \times 100$$

2.10. Specific gravity: Specific gravity of cucumber samples were determined by the method as described by AOAC (2000) using pycnometer. Briefly, the density of the cucumber was measured against the density of the water (standard). The empty weight of pycnometer was obtained and then filled with distilled water (at 20°C) and weighed. Similarly, each cucumber sample was filled in the pycnometer and weighed at same temperature. Samples were analyzed in duplicate batches. Then specific gravity was calculated by using following formula:

$$\text{Specific gravity} = \frac{\text{Weight of cucumber sample}}{\text{Weight of distilled water}}$$

3. SENSORY EVALUATION:

The sensory evaluation of samples was carried out by the panel of 10 judges for various attributes i.e. colour, taste, flavour, texture and overall acceptability by a nine point hedonic scale (representing number as 1 the most unacceptable while 9 indicated highly acceptable) as described by Amerine *et al.*, (1965).

4. RESULTS

4.1. Weight of cucumber (g): The results shows that maximum weight of cucumber (129.17 g) was noted where the cucumber packed in polyethylene bags under refrigeration temperature (12°C). The minimum weight of cucumber (85.16 g) was recorded under newspaper packing material stored at refrigeration temperature (12°C). The result further indicates that cucumber fruit achieved maximum weight when packed in polyethylene bags under refrigeration temperature as compared to news paper, grease free paper and control.

Table-1: Effect of wrapping materials at various temperatures on weight of cucumber.

Packing materials	Temperature	Days of interval					Mean
		0 day	3 day	8 days	12 days	16 days	
P ₁	T ₁	135.83	130.00	123.33	107.50	-	124.17 b
	T ₂	117.50	99.16	85.00	78.16	72.50	90.46 f
P ₂	T ₁	122.50	117.50	110.50	90.50	-	110.25 d
	T ₂	127.50	113.33	102.50	96.66	92.33	106.46 e
P ₃	T ₁	139.17	132.50	125.00	119.83	-	129.13 a
	T ₂	109.17	94.16	84.16	75.00	63.33	85.16 g
P ₄	T ₁	121.67	121.67	119.50	116.50	-	119.84 c
	T ₂	132.50	132.50	132.50	126.67	121.67	129.17 a

SE± = 8.1585

LSD 0.05% = 16.076

P₁= Control; P₂= Grease free; P₃= Newspaper; P₄= Polyethylene bag
 T₁= Ambient temperature (18±2⁰C); T₂= Refrigeration temperature (12⁰C)

4.2. Length of cucumber (cm): The data pertaining to the length of cucumber fruit indicates that maximum length of cucumber (18.67 cm) was noted where the cucumber packed in polyethylene bags under ambient temperature (18±2⁰C). The minimum length of cucumber (18.64 cm) was recorded for news paper under ambient temperature (18±2⁰C). It was observed that cucumber fruit reaching maximum length when packed in polyethylene bags under ambient temperature as compared to news paper, grease free paper and control.

Table-2 Effect of wrapping materials at various temperature on length of cucumber.

Packing materials	Temperature	Days of interval					Mean
		0 day	3 day	8 days	12 days	16 days	
P ₁	T ₁	17.85	17.26	16.58	16.01	-	16.93 d
	T ₂	18.50	18.08	18.00	17.71	17.43	17.94 c
P ₂	T ₁	18.88	18.46	17.95	17.45	-	18.19 b
	T ₂	18.33	17.96	17.58	17.23	16.75	17.57 c
P ₃	T ₁	17.66	17.33	16.45	15.90	-	16.84 d
	T ₂	19.93	19.88	19.60	19.28	18.90	19.52 a
P ₄	T ₁	18.85	18.80	18.61	18.40	-	18.67 b
	T ₂	17.50	17.50	17.33	17.26	17.00	17.32 c

SE± = 0.9521

LSD 0.05% = 1.8760

P₁= Control; P₂= Grease free; P₃= Newspaper; P₄= Polyethylene bag
 T₁= Ambient temperature (18±2⁰C); T₂= Refrigeration temperature (12⁰C)

4.3. Diameter of cucumber (cm): The data indicated that maximum diameter of cucumber (11.19 cm) were noted where the cucumber kept at control and minimum diameter of cucumber (10.03 cm) were recorded where the fruits packed in news paper under ambient temperature (18±2⁰C). The result concluded that cucumber fruit attain maximum diameter when the fruit were kept at control and minimum diameter of fruit recorded on newspaper under ambient temperature as compared to grease free paper and polyethylene bags.

Table-3 Effect of wrapping materials at various temperature on diameter of cucumber.

Packing materials	Temperature	Days of interval					Mean
		0 day	3 day	8 days	12 days	16 days	
P ₁	T ₁	11.21	10.85	10.55	10.28	-	10.72 b
	T ₂	11.46	11.43	11.23	11.01	10.80	11.19 a
P ₂	T ₁	10.85	10.76	10.43	10.18	-	10.56 c
	T ₂	11.10	11.05	10.76	10.33	10.05	10.66 b
P ₃	T ₁	10.33	10.25	9.88	9.66	-	10.03 d
	T ₂	11.31	10.08	10.71	10.45	10.23	10.56 c
P ₄	T ₁	11.07	11.00	10.96	10.71	-	10.94 b
	T ₂	11.08	10.88	10.41	10.20	9.93	10.50 c

SE± = 0.5550

LSD 0.05% = 1.0936

P₁= Control; P₂= Grease free; P₃= Newspaper; P₄= Polyethylene bag
 T₁= Ambient temperature (18±2⁰C); T₂= Refrigeration temperature (12⁰C)

4.2.1. Chemical analysis of cucumber

4.2.2. Moisture content (%)

The results showed that the maximum moisture content (74.07%) was determined when cucumber fruit was kept at control; while the minimum moisture content (68.01%) were recorded when the fruits packed in grease free paper under refrigeration temperature (12⁰C). Results further indicates that moisture content of cucumber was greater in control followed packing materials (grease free paper, news paper and polyethylene bags) at ambient and refrigeration temperatures.

Table-4 Effect of wrapping materials at various temperature on moisture content of cucumber.

Packing materials	Temperature	Days of interval					Mean
		0 day	3 day	8 days	12 days	16 days	
P ₁	T ₁	76.25	74.48	72.38	70.50	-	73.40 a
	T ₂	80.21	74.17	73.28	72.29	70.38	74.07 a
P ₂	T ₁	76.27	74.56	72.53	70.30	-	73.42 a
	T ₂	70.50	68.44	67.41	67.23	66.49	68.01 c
P ₃	T ₁	76.32	74.40	72.46	71.29	-	73.62 a
	T ₂	76.24	74.48	74.29	72.20	70.17	73.48 a
P ₄	T ₁	76.22	74.68	72.49	70.41	-	73.45 a
	T ₂	72.20	71.38	70.47	70.23	69.24	70.70 b

SE± = 3.7364

LSD 0.05% = 7.3622

P₁= Control; P₂= Grease free; P₃= Newspaper; P₄= Polyethylene bag
 T₁= Ambient temperature (18±2⁰C); T₂= Refrigeration temperature (12⁰C)

4.2.3. Ash content: The data indicated that maximum ash content of cucumber (0.90%) were noted where the cucumber kept in control and minimum ash content of cucumber (0.0.71%) were recorded where the fruits packed in grease free paper under ambient temperature (18±2⁰C). The result concluded that cucumber fruit with greater ash content was recorded in control group as compared to grease free paper, polyethylene bags and news paper.

Table-5: Effect of wrapping materials at various temperature on ash content of cucumber.

Packing materials	Temperature	Days of interval					Mean
		0 day	3 day	8 days	12 days	16 days	
P ₁	T ₁	0.86	0.80	0.94	0.98	0.86	0.71 b
	T ₂	0.93	0.90	0.89	0.85	0.96	0.90 a
P ₂	T ₁	0.92	0.97	0.74	0.95	0.92	0.71 b
	T ₂	0.88	0.85	0.88	0.84	0.94	0.87 a
P ₃	T ₁	0.96	0.95	0.96	0.94	0.96	0.76 b
	T ₂	0.86	0.93	0.95	0.94	0.97	0.92 a
P ₄	T ₁	0.96	0.94	0.96	0.94	0.96	0.75 b
	T ₂	0.85	0.93	1	0.89	0.91	0.88 a

SE± = 0.0539
 LSD 0.05% = 0.1062

P₁= Control; P₂= Grease free; P₃= Newspaper; P₄= Polyethylene bag
 T₁= Ambient temperature (18±2⁰C); T₂= Refrigeration temperature (12⁰C)

4.2.4. TSS content: The data indicated that maximum TSS content of cucumber (22.14%) were noted where the cucumber packed in news paper under refrigeration temperature (12⁰C) and minimum TSS content of cucumber (14.75%) were recorded where the fruits kept in polyethylene bags under ambient temperature (18±2⁰C). The result concluded that cucumber fruit with higher TSS content were noted when the fruit was packed in news paper under refrigeration temperature compared to grease free paper and newspaper.

Table-6 Effect of wrapping materials at various temperature on TSS of cucumber.

Packing materials	Temperature	Days of interval					Mean
		0 day	3 day	8 days	12 days	16 days	
P ₁	T ₁	2.85	3.26	5.06	5.21	-	16.38 c
	T ₂	2.87	3.47	4.22	4.97	5.80	21.33 a
P ₂	T ₁	2.89	3.98	4.90	5.05	-	16.82 c
	T ₂	2.85	3.35	4.31	4.96	5.69	21.16 a
P ₃	T ₁	2.88	3.36	4.65	5.25	-	16.14 c
	T ₂	2.85	3.60	4.63	5.19	5.87	22.14 a
P ₄	T ₁	2.86	3.55	4.00	4.34	-	14.75 d
	T ₂	2.83	3.10	3.90	4.47	5.10	19.40 b

SE± = 0.3560

LSD 0.05% = 0.7015

P₁= Control; P₂= Grease free; P₃= Newspaper; P₄= Polyethylene bag
 T₁= Ambient temperature (18±2⁰C); T₂= Refrigeration temperature (12⁰C)

4.2.5. pH value: The results showed that maximum pH value of cucumber (6.45) were noted where the cucumber fruit were kept at polyethylene bag under refrigeration temperature (18±2⁰C) and minimum pH value of cucumber (6.05) were recorded where the fruits packed in grease free paper under ambient temperature (18±2⁰C). The result further demonstrated that pH value of cucumber fruit reaching maximum level when kept at polyethylene bags under refrigeration temperature and minimum pH value was observed when the fruits packed in grease free paper under ambient temperature.

Table-7: Effect of wrapping materials at various temperature on pH of cucumber.

Packing materials	Temperature	Days of interval					Mean
		0 day	3 day	8 days	12 days	16 days	
P ₁	T ₁	6.11	6.30	6.37	6.85	-	6.41 a
	T ₂	6.21	6.27	6.39	6.61	6.75	6.40 a
P ₂	T ₁	6.18	6.21	6.10	5.70	-	6.05 a
	T ₂	6.11	6.21	6.36	6.51	6.69	6.38 a
P ₃	T ₁	6.51	6.22	5.93	5.55	-	6.05 a
	T ₂	6.05	6.17	6.40	6.58	6.79	6.40 a
P ₄	T ₁	6.77	6.28	5.99	5.72	-	6.19 a
	T ₂	6.12	6.31	6.44	6.61	6.78	6.45 a

SE± = 0.3560

LSD 0.05% = 0.7015

P₁= Control; P₂= Grease free; P₃= Newspaper; P₄= Polyethylene bag
 T₁= Ambient temperature (18±2⁰C); T₂= Refrigeration temperature (12⁰C)

4.2.6. Total acidity (%): The data indicated that maximum total acidity of cucumber (0.08%) were noted where the cucumber fruit were wrapped in control under both ambient and refrigeration temperature (18±2⁰C) and minimum total acidity of cucumber (0.07) were recorded where the fruits packed in grease free paper under ambient and refrigeration temperature (18±2⁰C). The result further confirmed that total acidity of cucumber fruit getting its maximum level when the fruit kept in control group under ambient and refrigeration temperature. The minimum total acidity of cucumber fruit was examined when the fruit wrapped in grease free paper under ambient and refrigeration temperature.

Table-8: Effect of wrapping materials at various temperature on total acidity of cucumber.

Packing materials	Temperature	Days of interval					Mean
		0 day	3 day	8 days	12 days	16 days	
P ₁	T ₁	0.08	0.08	0.08	0.08	-	0.08 a
	T ₂	0.08	0.08	0.08	0.08	0.08	0.08 a
P ₂	T ₁	0.07	0.07	0.07	0.07	-	0.07 b
	T ₂	0.07	0.07	0.07	0.07	0.07	0.07 b
P ₃	T ₁	0.08	0.07	0.08	0.08	-	0.08 a
	T ₂	0.08	0.08	0.07	0.07	0.07	0.07 b
P ₄	T ₁	0.08	0.08	0.08	0.08	-	0.08 a
	T ₂	0.08	0.08	0.08	0.07	0.07	0.08 a

SE± = 0.2245
 LSD 0.05% = 0.4424

P₁= Control; P₂= Grease free; P₃= Newspaper; P₄= Polyethylene bag
 T₁= Ambient temperature (18±2⁰C); T₂= Refrigeration temperature (12⁰C)

4.2.7. Specific gravity (%): The data indicated that maximum specific gravity of cucumber (0.79%) were noted where the cucumber fruit were wrapped in news paper under ambient and refrigeration temperature and minimum specific gravity of cucumber (0.0.77%) were recorded where the fruits packed in control under refrigeration temperature (12⁰C).The result

additionally incorrigible that cucumber fruits receiving maximum specific gravity when the fruit wrapped in news paper under ambient and refrigeration temperature. Whereas, the fruits getting minimum specific gravity when wrapped in control group.

Table-9: Effect of wrapping materials at various temperature on specific gravity of cucumber.

Packing materials	Temperature	Days of interval					Mean
		0 day	3 day	8 days	12 days	16 days	
P ₁	T ₁	0.81	0.76	0.79	0.75	-	0.78 c
	T ₂	0.78	0.78	0.79	0.69	0.80	0.77 d
P ₂	T ₁	0.76	0.79	0.78	0.77	-	0.77 d
	T ₂	0.77	0.76	0.77	0.78	0.79	0.77 d
P ₃	T ₁	0.75	0.83	0.80	0.84	-	0.81 a
	T ₂	0.75	0.77	0.87	0.86	0.72	0.79 b
P ₄	T ₁	0.75	0.79	0.85	0.77	-	0.79 b
	T ₂	0.75	0.80	0.81	0.76	0.79	0.78 c

SE± = 0.0425

LSD 0.05% = 0.0838

P₁= Control; P₂= Grease free; P₃= Newspaper; P₄= Polyethylene bag

T₁= Ambient temperature (18±2⁰C); T₂= Refrigeration temperature (12⁰C)

5. SENSORY ANALYSIS OF CUCUMBER

5.1. Color: The difference in color score of cucumber fruit between various packing materials were significant at probability level of (P<0.05). The data in Table-10; indicated that maximum color score of cucumber (7.33%) were noted where the cucumber fruit were wrapped in news paper under refrigeration temperature (12⁰C) and minimum color score of cucumber (5.74%) were recorded where the fruits packed in control under ambient temperature (18±2⁰C). The result furthermore, concluded that cucumber fruits receiving maximum score of color when the fruit wrapped in newspaper under refrigeration temperature. The fruits receiving minimum score of color when the fruit kept in control group.

Table-10: Effect of wrapping materials at various temperature on colour of cucumber.

Packing materials	Temperature	Days of interval					Mean
		0 day	3 day	8 days	12 days	16 days	
P ₁	T ₁	7.66	6.66	4.83	3.83	-	5.74 d
	T ₂	9.00	8.00	7.00	6.00	5.00	7.00 a
P ₂	T ₁	8.66	6.33	6.33	5.33	-	6.66 b
	T ₂	8.83	7.83	7.00	6.50	5.50	7.13 a
P ₃	T ₁	9.33	7.16	7.00	5.83	-	7.33 a
	T ₂	8.33	7.50	6.50	5.66	5.00	6.59 c
P ₄	T ₁	8.50	7.33	5.33	4.66	-	6.45 c
	T ₂	8.83	7.83	6.83	5.83	4.66	6.79 b

SE± = 0.3657

LSD 0.05% = 0.7206

P₁= Control; P₂= Grease free; P₃= Newspaper; P₄= Polyethylene bag
 T₁= Ambient temperature (18±2^oC); T₂= Refrigeration temperature (12^oC)

5.2. Taste: The data in Table-11; indicated that maximum taste score of cucumber (6.67) were noted where the cucumber fruit were wrapped in polyethylene bags under refrigeration temperature (12^oC) and minimum taste score of cucumber (4.96) were recorded where the fruits kept in control under refrigeration temperature (12^oC). The results with respect to the taste score of cucumber fruit was analyzed and ANOVA demonstrated significant (P<0.05) difference between wrapping materials and temperatures. The difference in taste score of cucumber fruit between various packing materials were significant at probability level of (P<0.05). The result furthermore concluded that cucumber fruits receiving maximum score of taste when the fruit wrapped in polyethylene bags under refrigeration temperature. The fruits receiving minimum score of taste when kept at control group.

Table-11: Effect of wrapping materials at various temperature on taste of cucumber.

Packing materials	Temperature	Days of interval					Mean
		0 day	3 day	8 days	12 days	16 days	
P ₁	T ₁	8.50	7.16	5.33	3.50	-	6.12 c
	T ₂	7.00	6.00	5.16	4.16	2.50	4.96 d
P ₂	T ₁	9.00	6.66	5.16	3.50	-	6.08 c
	T ₂	8.00	7.00	6.16	5.16	3.50	5.96 d
P ₃	T ₁	8.66	7.83	5.66	3.83	-	6.50 b

Tahseen Fatima Miano, Arshad Ali Khaskheli, Tanveer Fatima Miano, Falak Naz Miano- **Influence of Packaging Material on Physico-Chemical and Sensory Quality of Cucumber under Ambient and Refrigeration Temperatures**

	T ₂	8.50	7.50	6.83	5.83	3.66	6.46 b
P ₄	T ₁	8.66	7.50	5.83	4.50	-	6.62 a
	T ₂	9.00	8.00	7.00	5.83	3.50	6.67 a

SE± = 0.3328

LSD 0.05% = 0.6557

P₁= Control; P₂= Grease free; P₃= Newspaper; P₄= Polyethylene bag
 T₁= Ambient temperature (18±2⁰C); T₂= Refrigeration temperature (12⁰C)

5.3. Tenderness: The result for tenderness score of cucumber fruit shown in Table-12; indicated that maximum tenderness score of cucumber (6.75) were noted where the cucumber fruit were kept at control under ambient temperature (18±2⁰C) and minimum tenderness score of cucumber (5.43) were recorded where the fruits packed in grease free paper under refrigeration temperature (12⁰C). It was concluded that cucumber fruits receiving maximum score of tenderness when the fruit kept at control under ambient temperature. ANOVA indicates non-significant (P>0.05) difference between wrapping materials and temperatures. The difference in tenderness score of cucumber fruit between various packing materials were non-significant at probability level of (P>0.05).

Table-12: Effect of wrapping materials at various temperature on tenderness of cucumber.

Packing materials	Temperature	Days of interval					Mean
		0 day	3 day	8 days	12 days	16 days	
P ₁	T ₁	9.16	8.00	6.16	3.66	-	6.75 a
	T ₂	8.83	7.16	6.00	5.00	3.50	6.10 c
P ₂	T ₁	9.00	8.00	6.50	4.16	-	6.92 a
	T ₂	7.66	6.50	5.50	4.50	3.00	5.43 d
P ₃	T ₁	8.83	7.50	5.50	3.83	-	6.42 b
	T ₂	8.16	7.16	6.16	5.16	4.16	6.16 c
P ₄	T ₁	9.00	7.66	5.33	3.66	-	6.41 b
	T ₂	7.66	6.83	5.83	4.83	3.83	5.80 d

SE± = 0.3212

LSD 0.05% = 0.6330

P₁= Control; P₂= Grease free; P₃= Newspaper; P₄= Polyethylene bag
 T₁= Ambient temperature (18±2⁰C); T₂= Refrigeration temperature (12⁰C)

5.4. Appearance: Appearance of cucumber fruit were evaluated by a panel of judges at Laboratory of Food Sciences and Technology. The data interpreted, analyzed and presented in Table-13; which showed that maximum appearance score of cucumber (6.36) were noted where the cucumber fruit were wrapped in polyethylene bags under refrigeration temperature (12°C) and minimum appearance score of cucumber (5.83) were recorded where the fruits packed in news paper under ambient temperature (18±2°C). The results further indicates that cucumber fruit showed improvement in appearance when the fruit stored at polyethylene bags at refrigeration temperature, but no significant changing were observed in appearance of cucumber when it stored at ambient temperature under various wrapping materials. Statistically the difference in tenderness of cucumber fruit between various wrapping materials and temperatures were non-significant (P>0.05).

Table-13: Effect of wrapping materials at various temperature on appearance of cucumber.

Packing materials	Temperature	Days of interval					Mean
		0 day	3 day	8 days	12 days	16 days	
P ₁	T ₁	8.50	7.16	5.50	3.66	-	6.21 c
	T ₂	9.00	7.83	6.00	4.16	2.83	5.96 d
P ₂	T ₁	8.33	6.83	5.16	3.50	-	5.96 d
	T ₂	8.83	7.66	6.00	4.83	3.83	6.23 c
P ₃	T ₁	7.83	6.66	5.33	3.50	-	5.83 d
	T ₂	9.00	7.66	6.33	5.33	4.33	6.53 a
P ₄	T ₁	8.00	6.83	5.16	3.50	-	5.87 d
	T ₂	9.33	7.50	6.33	5.16	3.50	6.36 b

SE± = 0.2489

LSD 0.05% = 0.4905

P₁= Control; P₂= Grease free; P₃= Newspaper; P₄= Polyethylene bag

T₁= Ambient temperature (18±2°C); T₂= Refrigeration temperature (12°C)

5.5. Overall acceptability: The result for overall acceptability of cucumber fruit were evaluated and the data presented in Table-14; which revealed that maximum overall acceptability score of cucumber (29.97) were noted where the cucumber fruit were wrapped in grease free paper under refrigeration

temperature (12°C) and minimum overall acceptability score of cucumber (22.00) were recorded where the fruits kept at control under ambient temperature (18±2°C). Statistically the difference in tenderness of cucumber fruit between various wrapping materials and temperatures were non-significant (P>0.05). The results further indicates that cucumber fruit showed better scoring for overall acceptability when the fruit stored at grease free paper at refrigeration temperature. Minimum score for overall acceptability of cucumber fruit were observed when the cucumber fruit were kept in control group.

Table-14: Effect of wrapping materials at various temperature on overall acceptability of cucumber.

Packing materials	Temperature	Days of interval					Mean
		0 day	3 day	8 days	12 days	16 days	
P ₁	T ₁	32.16	25.83	19.16	10.83	-	22.00 d
	T ₂	39.16	34.16	29.66	25.00	20.00	29.60 a
P ₂	T ₁	39.16	29.50	22.00	12.83	-	25.87 c
	T ₂	40.33	35.00	30.00	25.00	19.50	29.97 a
P ₃	T ₁	42.83	30.33	22.50	13.33	-	27.25 b
	T ₂	38.83	34.50	29.50	23.66	20.83	29.46 a
P ₄	T ₁	31.66	26.66	22.16	13.83	-	23.58 d
	T ₂	39.50	35.00	29.16	24.16	19.16	29.40 a

SE± = 1.5196

LSD 0.05% = 0.0838

P₁= Control; P₂= Grease free; P₃= Newspaper; P₄= Polyethylene bag
 T₁= Ambient temperature (18±2°C); T₂= Refrigeration temperature (12°C)

6. DISCUSSION:

In the current study average weight and length of cucumber was greater when wrapped in polyethylene bags, diameter was greater when kept at control. Chemical properties of cucumber indicates that moisture content, ash content, pH, total acidity, were higher in control group compared to treatment groups. Maximum TSS content were noted where the cucumber packed in news paper under refrigeration temperature (12°C). Specific gravity of cucumber fruit were higher when wrapped in news paper under ambient and refrigeration temperature. Sensorial

analysis of cucumber showed that maximum color score of cucumber were noted where the cucumber fruit were wrapped in news paper under refrigeration temperature (12°C). Taste score were higher when wrapped in polyethylene bags under refrigeration temperature (12°C). Tenderness score were higher when the fruit kept at control under ambient temperature (18±2°C). Appearance score was greater when fruit was wrapped in polyethylene bags under refrigeration temperature (12°C). Maximum overall acceptability score of cucumber was greater when wrapped in grease free paper under refrigeration temperature (12°C). Present findings of the current study was supported with (Mahajan *et al.*, 2014) packaging materials enhanced the physio chemical properties of cucumber without undesirable effects on quality. (Manjunatha and Anurag 2014) revealed that cucumber can be stored under MAP with 2 perforations at 4 ± 1 °C and 90 ± 2 % RH and ambient condition (23–26 °C and 63–66 % RH) for 12 and 6 days, respectively. Sudhakar and Shivashankara (2014) reported that packaging materials significantly improves that nutritional quality of cucumber at ambient temperature (24–32 °C and 60–70 % RH) with good surface yellow colour (reflected by hue and chroma values), edible softness, retention of nutritional quality and acceptable organoleptic quality. (Xiangyong *et al.*, 2014) they concluded that packaging material was helpful to preserve quality of fresh-cut cucumbers. (Dhall *et al.*, 2013) specifies that sensory attributes score was highest in shrink wrapped cucumbers as related to unwrapped cucumbers at the end of both storage conditions. Thus, it can be determined that single shrink wrapped (60 gauge) cucumber can be kept well up to 15 days at 12±1°C and 90-95% RH and for 5 days at ambient circumstances (29-33°C, 65-70% RH) with maximum holding of green color, no spoilage, lowest weight and firmness loss and very good sensory quality attributes whereas, unwrapped fruits can be stored well up to 9 days at 12±1°C and 90-95% RH and

for 2 days at ambient conditions with maximum retention of physico-chemical quality attributes. (Marcel, 2013). The highest values of ascorbic acid (vitamin C) were recorded in the samples where used non-iodized salt. The greatest percentage reduction of ascorbic acid was after 15 days of packaging in papers. (Sen, 2013) reported that generally effects of packages on chemical attributes of cucumbers did not create significant differences. Research results showed that long cucumbers no packed or wrapped with shrink film would be stored for 20 days, on the other hand MA package extended storage period to 30 days. (Cazier and Baptiste, 2012) reported that a reduction of moisture loss was of highest importance in the preservation of cucumber mass. Both respiration and transpiration rates were strongly influenced by the surrounding temperature and relative humidity. Film wrapping reduced significantly the effect of surrounding temperature and relative humidity. (Dhall *et al.* 2012) concluded that individual shrink wrapped cucumber can be stored well upto 15 days at 12 ± 1 °C and 90–95% RH and for 5 days at ambient conditions (29–33 °C, 65–70% RH) with maximum retention of green colour, no spoilage, minimum weight and firmness loss and very good sensory quality attributes whereas, unwrapped fruits can be stored well upto 9 days at 12 ± 1 °C and 90–95% RH and for 2 days at ambient conditions with maximum retention of physico-chemical quality attributes. (Fahad *et al.* 2012) reported that sensory characteristics of cucumber such as color, taste, tenderness, appearance and overall acceptability of coated (5-20%) cucumbers were much better preserved while storing at 10 and 25°C for 16 days.

7. CONCLSUION:

Keeping in view of the facts stated above, it was concluded that packaging materials (newspaper and polyetyhylene bags)

significantly enhanced the weight, length, diameter, TSS, pH, Total acidity, colour, taste, appearance and overall acceptability of cucumber fruit under ambient and refrigeration temperature.

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