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QUALITY CHARACTERISTICS OF NOVEL DEHYDRATES FRUIT SHEETS.

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ABSTRACT

New different products from cantaloupe, peach and apricot either alone or blends of them with different ratio were prepared and dehydrated in sheet form. The effect of dehydration and storage for 9 months at ambient temperature, on chemical, microbiological and sensory characteristics were evaluated. The results showed that, dehydration process caused to increase of reducing sugars and acidity while total sugars, non reducing sugars, protein, ascorbic acid and carotenoids were decreased. Ether extract, ash and fiber contents were not changed. During storage, the moisture content, acidity and reducing sugars were increased gradually but other tested compounds were negligibly affected. For mineral contents, the cantaloupe sheet had the highest Na, K, Mg and Zn contents while apricot sheet had the highest for Ca and Fe content, while the highest P content was obtained by peach sheet. The total bacterial count (TBC) decreased gradually during storage and all samples were freedom from mold and yeast growth after drying and storage. For sensory evaluation, all samples were accepted by the panelists after 9 months of storage. Generally, blending cantaloupe with apricot or peach improving the sensory parameters for produced sheets.

INTRODUCTION

Drying of foodstuffs is the cheapest food preservation methods since it is applicable to a wide range of industrial and agricultural products (Togrul and Pehlivan, 2003). Apricots are generally dried from initial moisture content of about 74 – 78 % to 16 – 18 % for effective storing, marketing and processing. Dried apricots are in excessive demand in several parts of the worldwide. Fresh apricot is rich source of protein containing major essential and nonessential amino acids (Gandhi, *et al*., 1997). In Egypt and most Arabic countries, apricot sheet (Kamar El-Din) is a favorite drink which is often in Ramadan month. Peach are used primarily for processing peach puree which is used in baby foods, preserves and other processed products (Tidwell, *et al*., 1997). Cantaloupe is highly appreciated for its nutritional quality and special flavor. Processed cloudy melon juice could be a best way to raise merchandise rate of cantaloupe and to prolong industrial chain (Ma, *et al*., 2007). Cantaloupe fruit are regarded as a good sources of ascorbic acid and can be reasonably high in sugar content, which wide variation in soluble solids being reported for different cultivars (Galeb, *et al*. 2002). For these characteristics of cantaloupe addition to low cost and the longer season compared to apricot, so the aim of this investigation is to produce a new products in sheet from cantaloupe alone or cantaloupe mix with apricot and / or peach at different percentage. Moreover, this study aims to evaluate the chemical, microbiological and sensory characteristics of produced sheets as function of processing and storage for 9 months at ambient temperature.

MATERIALS AND METHODS

Materials :-

Fresh fruit of peach (*Prunus persica*) canino variety and fresh fruit of apricot (*Prunus armaniaca*) Florida prine variety were obtained from El-deblomasian station, Wady El-Natron, Egypt. Fresh fruit of cantaloupe (*Cucumis melo*) honeydew variety were obtained from local market, Nasr city, Cairo, Egypt.

Methods:-

Preparation of cantaloupe fruit pulp :-

The fruit were manually peeled , crushed, blanched at 80 ^{o}C for 10 min. and screened (total soluble solids about 10 %). The total soluble solids (TSS) of the prepared pulp were modified to be 15 % by sugar addition. The mixture was heated to 80 ^{o}C for 20 min., then carboxy methyl cellulose (0.25%) and sodium metabisulphite (5g/kg) were added.

Preparation of apricot and peach fruit pulps :-

The apricot and peach fruit pulps were prepared as previously mentioned after removing of stones and crushing.

Preparation of sheet formulas :-

The mixtures of sheet pulps were prepared by blending of previously prepared cantaloupe, apricot and peach fruit pulps as follows:-

Formulas of prepared pulps sheet.

Treatment No.	Fruit / Mix	Mixing ratio
1	Apricot (A)	No mixing
2	Peach (P)	No mixing
3	Cantaloupe (C)	No mixing
4	A + P	1 : 1
5	A + C	1 : 1
6	P + C	1 : 1
7	A + P + C	1 : 1: 1
8	A + P + C	2 : 1 : 1
9	P + A + C	2 : 1 : 1
10	C + A + P	2 : 1 : 1

The blended mixtures of fruit pulps (sheet mixtures) were poured in aluminum tray covered with thin layer of olive oil, the thickness of the poured mixtures was 0.5 – 0.8cm. Drying process was carried out in an air dryer oven at 80 ^{o}C for 2 – 4 hrs and then completed at 60 ^{o}C for 16 – 20 hrs. The dried sheets were rolled and wrapped in cellophane films and stored at room temperature for9 months.

Chemical and physical analyses :-

Moisture content, ether extract, protein (calculated using protein factor 6.25), ash (550 ^{o}C), total fiber, total sugars (reducing and non reducing), pH value was then measured using (Beckman model 3550 digital pH meter, total acidity as citric acid/ 100g, total soluble solids (T.S.S.) by Abbe refractometer at 20 ^{o}C and ascorbic acid by 2,6 dichlorophenol endophenol titrable method were determined according to the methods of AOAC (2000). Carotenoids were determined by method described by Luch *et al*. (1985).

Minerals content:-

Calcium, iron and zinc were determined according to the method of AOAC (2000) using Atomic Absorption spectrophotometer – Perkin Elmer-Model 5000, Germany. Phosphorus was determined by spectrophotometer using molybdovandate method according to AOAC (2000), while sodium and potassium were determined by flame photometer (Corning 400, Serial No. 4889. UK).

Microbiological analysis:-

Both total viable bacterial count, mold and yeast were enumerated on plate count agar (PCA) and potato dextrose agar (PDA) respectively as recommended by FAO (1992).

Sensory evaluation:-

Sensory characteristics (color, odor, taste, texture and overall acceptability) were evaluated by ten staff members of the department of Food Science and Technology, Faculty of Agriculture, Al –Azhar University using a numerical scale from 1 – 10 point according to the method of Chang *et al*. (1994).

Statistical analysis:-

The data of sensory evaluation analysis of this experiment was carried out by one way analysis of variance and least significant difference (LSD) were conducted to test significant among the treatment means (Steel and Torrie 1980), significant was assumed at ($P \leq 0.05$).

RESULTS AND DISCUSSION

Effect of drying process on chemical composition of fresh sheets:-

The chemical composition of the produced fruit sheets using different formulas of mixed fresh pulps were determined before and after drying and the results are presented in table (1 and 2).

From the results it could be seen that, the cantaloupe sheet was the highest in ether extract, total and reducing sugars, ascorbic acid and total carotenoids, while apricot sheets was highest in protein and ash contents. The peach sheet had the highest fiber content and total acidity. All studied pulp samples had total solids about 15 % nearly, this mainly related to the addition of sucrose (about 5 %) during preparation. Thus, the non-reducing sugars were in lower amounts after drying in all studied samples, this may be attributed to that there was some hydrolysis could be occurred in sucrose as affected by heat of drying in the presence of natural organic acids (Shahat, 1986). This emphasized by the arising of reducing sugars after dehydration. However, the slight decrement of total sugars and protein contents were observed in all studied samples as affected by drying, this may be due to some reaction of Millared could be favoured by drying condition (Galeb *et al*., 2002).

The same tables (1 and 2) also show that, the slight increase of organic acids (acidity) that occurred during dehydration may be resulted from some degradation of monosaccharides (reducing sugars by drying heat to acid compounds (Salama, 2000).

Ascorbic acid distinctly decreased after drying in all studied samples. This decrements are due mainly to oxidation, however, it may be also attributed to the non-enzymatic discoloration (Sheachea, 1995).

Carotenoids seemed to be unstable since it decreased which may be due to the thermal treatment during the drying process.

Finally, the ether extract, ash and fiber contents did not exhibit remarked changes as a result to dehydration.

Effect of storage period on the characteristics of different produced dried fruit sheets:-

Effects of storage (for 9 months at room temperature) on the major characteristics of produced dried sheets were estimated at 3 months interval. The results are tabulated in tables (3 and 4). From the results, it could be observed on changes of some chemical characteristics of produced dried sheets as affected by storage. The moisture content, total acidity (table 3) and reducing sugar (table 4) were increased gradually (by varied rates) through the storage period of all produced dried sheets.

The moisture increment could be explained by the phenomenon of the ability of dried sheets to absorb moisture during storage (Salama, 2000).

Raya (1998) reported that, the reducing sugar is considered as the major participants of Millared reaction during drying or storage. The acidity were slightly increased in slow gradually rate during storage, this may be related to the third stage of Millard reaction constituents some acidic fragments are also attributed to conversion of some reducing sugar to acidic compounds (Shahat, 1986).

On the other hand, the non-reducing sugars content (table 4) of all produced dried sheets were gradually decreased during storage. This may be related to the non-reducing sugar are inverted to reducing sugars.

Also, the protein content (table 3) was gradually decreased in slight rate, this may be attributed to the nitrogenous compounds was interacted with reducing sugars (Millard reaction) at room temperature forming browning pigments (Lee and Chen, 1998).

Slight decreases in carotenoides (table 4) contents were showed in all produced dried sheets during storage, similar results were noticed by El-Sherife (1996) for dried apricot sheets.

Ascorbic acid was also gradually decreased during storage, this might be related to direct oxidation or conversion to hydroascorbic acid which rapidly react with amino acids to produce a type of red pigments (Lee and Chen, 1998). It was also shown that sulfuring exerted it action on protecting vitamins from complete loss through the storage period.

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Finally, ether extract and ash contents exhibited negligible or almost no changes due to storage of the different dried sheets during storage. Similar trend was found by Shahat (1986), Raya (1998) and Salama (2000).

Mineral contents of produced dried fruit sheets:-

The amounts of some important mineral elements in different produced dried fruit sheets are shown in table (5). From the obtained results it could be observed that, the cantaloupe sheet had highest of Na, K , Mg and Zn contents while apricot sheet had highest for Ca and Fe contents. The highest P content was obtained by peach sheet.

Sodium content ranged from 0.40 – 20.00 mg / 100 g dry basis for peach and cantaloupe dried sheets respectively.

Among all determined mineral elements potassium was found to be the dominant elemental in all tested samples. K ranged from 200 for apricot sheet to 330 mg/100 g for cantaloupe sheet.

For Calcium content, the apricot sheet had highest value (16 mg) while, the lowest value was obtained by cantaloupe sheet (6.0 mg).

No great variation between different produced fruit sheet for magnesium content, the values ranged from (9 – 10 mg).

The peach sheet had highest value (68.0 mg) of P content, while apricot and cantaloupe had lowest similar value 20.0 and 21.0 mg / 100 g respectively.

It was known that adequate iron in a diet is very important for decreasing the incidence of anemia. The concentration of iron were observed in the range of 0.20 – 0.62 mg / 100g for cantaloupe and apricot sheets respectively.

Zinc is an essential metal for the normal function of various enzyme systems. The cantaloupe sheet had the highest value for zinc content (3.10 mg), while the lowest value (0.10 mg / 100 g) was obtained by peach sheet.

From the present results it could be observed that, there are a wide variation of mineral content between different produced fruit sheets. But, all produced fruit sheets were rich in mineral contents. Saracoglu *et al*., (2009) reported that, such elements as iron and zinc are essential elements since they play an important role in biological system and are essential for normal development and function human cells.

Table (5): Mineral content (mg / 100 g on dry basis) of produced fruit sheets.

Component	Na	K	Ca	Mg	P	Fe	Zn
Treatments							
A	2.00	200.0	16.0	9.0	20.00	0.62	0.69
P	0.40	204.0	8.0	9.2	68.00	0.41	0.10
C	20.00	330.0	6.0	10.0	21.00	0.20	3.10
A + P (1:1)	1.20	202.0	12.0	9.1	44.00	0.51	0.40
A + C (1:1)	11.00	265.0	11.0	9.5	20.50	0.40	1.85
P + C (1:1)	10.20	267.0	7.0	9.6	44.50	0.30	1.65
A+P+C(1:1:1)	7.47	244.5	10.0	9.4	36.33	0.40	1.32
A+P+C(2:1:1)	6.10	233.5	11.5	9.3	32.25	0.45	1.75
P+A+C(2:1:1)	5.70	234.5	9.5	9.4	44.25	0.40	1.03
C+A+P (2:1:1)	10.60	266.0	9.0	9.6	32.50	0.35	1.80

Effect of storage period (9 months) at room temperature on microbial characteristics of produced fruit sheets.

Table (6) shows the TBC of different produced fruit sheets immediately after processing (zero time) as well as during 9 month of storage at room temperature. From the table it could be observed that, the produced fruit sheets contained different bacterial loads after drying ranged from 19 × 10^2 cfu / g for sheet which consists of A+P+C (1: 1 : 1) to 29 × 10^2 cfu / g for sheet which consists of A+P (1 : 1).

Table (6): Effect of storage period (months) at room temperature on total bacterial count (TBC) of produced fruit sheets.

TBC × 10^2 (CFU / gm)				
Storage months	**0**	**3**	**6**	**9**
Treatments				
A	20	16	14	14
P	23	22	22	17
C	25	24	24	20
A + P (1:1)	29	22	18	17
A + C (1:1)	26	23	20	15
P + C (1:1)	26	22	20	19
A+P+C(1:1:1)	19	16	17	13
A+P+C(2:1:1)	21	18	16	16
P+A+C(2:1:1)	26	16	16	15
C+A+P (2:1:1)	28	19	18	15

During storage period, the TBC decreased gradually in all tested samples. After 9 months from storage the TBC ranged from 13 to 20 × 10^2 cfu / g for A+P+C (1: 1 : 1) sheet and cantaloupe sheet respectively.

In the same time all produced fruit sheets exhibited their freedom for mold and yeast contamination after drying and after storage for 9 months at room temperature.

The microbial stability of sheets during storage may be attributed to the low moisture content (due to sucrose addition and moisture removal by drying) as well as to the preservative action of metabisulfite which added during the preparation process (Salama, 2000). Frazier and Westhoff (1988) reported that, the drying of fruits usually causes a reduction in total numbers of microorganisms usually all yeasts and most bacterial are destroyed.

Also, Duxbury (1993) reported that the good storage conditions can improve the microbial quality of dried fruit during storage.

Canellas, et al., (1993) reported that the microbial density of dried apricot depends on the pre-treatments as well as the applied drying. When the moisture level was kept low in the package, the number of bacteria and mold present in the dried fruits decrease during storage period (Marion, 1988).

Sensory evaluation of produced fruit sheets during storage :-

Sensory characteristics of produced fruit sheets (color, taste, odor, texture and overall acceptability) were evaluated after processing and during (9) months storage period at room temperature (table 7).

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From the table, it could be observed that, the A and A + C (1 : 1) sheets had been given the highest score in all sensory characteristics except for the texture parameter and there were significant differences ($P < 0.05$) among all samples for sensory attributes.

On the other hand C sheet had the lowest score in all sensory parameter, but when mixed with apricot or peach improving the sensory parameter.

Moreover, there was no significant differences between sheets from (A + P + C 1 : 1 : 1), (A + P + C 2 : 1 : 1), (P + A + C 2:1: 1) and (C + A + P 2: 1: 1) in all sensory characteristics except for the texture parameter.

In general, it could be concluded that, all samples were accepted by the panelists after 9 months of storage. However, significant differences ($P \leq 0.05$) in all sensory characteristics where observed between zero time and after storage for 9 months in all studied samples.

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صفات الجودة للفائف الفاكهة المجففة غير المألوفة

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نظرا لرخص سعر ثمرة الكانتلوب وتوافرها في السوق المحلي لفترة طويلة من العام وتميزها بصفات جودة عالية مقارنة بالمشمش والخوخ. فقد تم عمل لفائف الكانتلوب والمشمش والخوخ منفردة أو مخلوطة معاً بنسب مختلفة. وقد تم دراسة تأثير كل من عمليتي التجفيف والتخزين لمدة تسعة أشهر علي درجة حرارة الغرفة علي كل من التركيب الكيماوي – النشاط الميكروبي – التقييم الحسي للفائف الناتجة. وقد أظهرت النتائج المتحصل عليها أن عملية التجفيف أحدثت زيادة في كل من السكريات المختزلة والحموضة الكلية وأحدثت نقصاً في كل من قيم السكريات الكلية – السكريات غيرالمختزلة – البروتين – فيتامين جـ والكاروتينات. ومن ناحية أخري فإن قيم كل من المستخلص الإيثيري والرماد والألياف لم تظهر تغيراً ملحوظاً بعملية التجفيف.

وأثناء التخزين لمدة تسعة أشهر علي درجة حرارة الغرفة حدثت زيادة تدريجية في كل من المحتوي الرطوبي – الحموضة الكلية والسكريات المختزلة ولكن المكونات تحت الدراسة الأخرى حدث بها نقص خفيف أو لم تتأثر بعملية التخزين وبالنسبة لمحتوي اللفائف الناتجة من المعادن فقد أظهرت اللفائف المصنوعة من الكانتلوب بأنها أعلي في كل من الصوديوم و البوتاسيوم و الماغنسيوم والزنك بينما لفائف المشمش كانت أعلي في قيم كل من الكالسيوم والحديد فقط ومع ذلك كانت أعلي نسبة لعنصر الفوسفور في اللفائف المصنوعة من الخوخ. كما أظهرت نتائج الاختبارات الميكربيولوجية خلو اللفائف نهائياً من الفطر والخميرة سواء بعد التصنيع مباشرة وحتى بعد تسعة أشهر من التخزين علي درجة حرارة الغرفة كما أظهرت النتائج أيضاً احتواء اللفائف علي عدد قليل من العدد الكلي للبكتيريا وحدث له انخفاض تدريجي أثناء التخزين.

وأخيرا فيما يتعلق بالتقييم الحسي للفائف الناتجة فإن جميع اللفائف كانت مقبولة حسياً حتى بعد تسعة أشهر من التخزين علي الرغم من وجود فروق معنوية في جميع اللفائف بالتخزين ومما هو جدير بالذكر أن خلط الكانتلوب مع المشمش والخوخ أدي إلي تحسين صفاته الحسية بدرجة كبيرة مما يوصي باستخدامه في عمل اللفائف نظرا للأسباب سابقة الذكر.

قام بتحكيم البحث

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Table (1): Effect of drying process on some components of produced fruit sheets, using different formulas of mixed fresh fruit pulps (on dry weight basis).

Component	% Moisture		% Ether extract		% Protein		% Ash		% Fiber		% Total acidity	
Treatments	BD	AD	BD	AD	BD	AD	BD	AD	BD	AD	BD	AD
A	85.11	10.57	1.77	1.88	4.78	4.67	5.13	5.39	4.55	4.45	0.75	1.16
P	85.12	10.03	2.01	2.15	3.71	3.56	3.96	4.17	5.90	5.76	0.81	1.18
C	86.02	13.46	2.25	2.22	3.51	2.31	4.22	4.53	5.16	5.28	0.62	0.96
A + P (1:1)	85.92	9.30	1.42	1.65	4.68	4.40	5.88	5.92	5.63	5.57	0.82	1.14
A + C (1:1)	85.61	12.50	1.97	2.28	4.37	4.23	5.25	5.23	5.04	5.34	0.68	1.05
P + C (1:1)	85.01	9.77	1.73	1.82	4.73	4.61	4.40	4.68	4.89	4.77	0.74	1.15
A+P+C(1:1:1)	85.44	9.99	1.84	1.71	4.44	4.13	5.38	5.65	5.80	5.69	0.70	1.13
A+P+C(2:1:1)	85.11	15.61	1.30	1.44	4.75	4.65	5.03	5.41	5.67	5.03	0.71	1.13
P+A+C(2:1:1)	84.91	13.83	1.39	1.48	3.97	3.75	4.04	4.24	5.70	5.57	0.68	1.14
C+A+P (2:1:1)	85.22	14.26	1.59	1.71	4.67	4.59	6.12	6.52	5.25	5.18	0.69	1.19

BD: before drying ; AD : after drying.
A : Apricot.
P : Peach.
C : Cantaloupe.

Tabl (2): Effect of drying process on sugars , ascorbic acid and carotenoieds composition of produced fruit sheets , using different formula of mixed fresh pulps (on dry weight basis

Component	Sugars						Ascorbic acid Mg/100gm		Carotenoieds Mg/100gm	
	Total		Reducing		Non reducing					
Treatments	BD	AD	BD	AD	BD	AD	BD	AD	BD	AD
A	82.04	81.90	28.71	32.38	53.33	49.52	140	17.88	10.90	7.14
P	82.12	81.98	29.55	33.52	52.34	48.46	175	18.44	3.29	3.01
C	83.00	82.39	34.50	38.72	48.50	43.57	216	27.94	39.75	11.00
A + P (1:1)	80.43	80.24	31.25	34.47	49.18	45.77	142	18.53	7.24	6.83
A + C (1:1)	81.09	80.88	34.15	37.99	46.94	42.89	208	24.18	22.37	9.26
P + C (1:1)	82.51	82.11	33.15	36.42	49.36	45.68	187	24.56	17.67	7.43
A+P+C(1:1:1)	80.48	80.25	32.15	34.90	48.33	45.35	167	22.76	16.59	8.00
A+P+C(2:1:1)	81.25	81.17	32.21	35.15	49.04	46.02	201	20.22	16.70	9.19
P+A+C(2:1:1)	82.51	82.37	31.85	34.18	50.66	48.19	179	18.15	13.12	9.30
C+A+P (2:1:1)	80.65	80.26	34.11	38.47	46.54	41.79	160	22.34	21.62	9.49

BD : before drying ; AD : after drying.

Table (3): Changes occurred in moisture, oil, protein, ash and total acidity of produced dried sheets during (9 months)of storage at room temperature.

Component	Moisture			Oil			Protein			Ash			% Total acidity		
Storage months / Treatments	3	6	9	3	6	9	3	6	9	3	6	9	3	6	9
A	10.75	10.93	11.00	1.86	1.87	1.87	4.66	4.65	4.64	5.34	5.37	5.37	1.22	1.27	1.34
P	10.20	10.36	10.89	2.12	2.14	2.13	3.51	3.44	3.42	4.12	4.16	4.13	1.23	1.30	1.37
C	13.87	14.04	14.27	2.21	2.21	2.20	2.29	2.29	2.29	4.50	4.50	4.49	1.04	1.11	1.22
A + P (1:1)	9.80	10.01	10.28	1.62	1.64	1.63	4.37	5.36	5.34	5.82	5.88	5.86	1.23	1.30	1.38
A + C (1:1)	12.71	12.82	12.92	2.26	2.27	2.27	4.22	5.21	5.20	5.16	5.21	5.20	1.12	1.21	1.33
P + C (1:1)	10.80	10.47	10.78	1.80	1.80	1.80	4.60	4.58	4.56	4.62	4.64	4.62	1.22	1.29	1.36
A+P+C(1:1:1)	10.28	10.58	10.84	1.69	1.70	1.69	4.11	5.10	5.08	5.59	5.62	5.60	1.21	1.30	1.37
A+P+C(2:1:1)	15.77	16.84	16.97	2.44	2.41	2.40	4.63	4.68	4.67	5.40	5.33	5..32	1.21	1.31	1.43
P+A+C(2:1:1)	14.09	14.71	14.75	1.47	1.46	1.46	3.74	3.71	3.71	4.23	4.20	4.20	1.20	1.25	1.36
C+A+P (2:1:1)	14.78	14.83	14.84	1.70	1.70	1.70	4.51	4.91	4.91	6.48	46.47	6.48	1.23	1.27	1.34

Table (4): Changes occurred in sugars, ascorbic acid and total carotenoid contents of produced dried sheets during (9 months)of storage at room temperature.

Component	Sugars									Ascorbic acid Mg/100gm			Caratenoieds Mg/100gm		
	Total			Reducing			Non reducing								
Storage months / Treatments	3	6	9	3	6	9	3	6	9	3	6	9	3	6	9
A	81.72	81.53	80.23	33.11	33.56	33.98	48.61	47.97	46.25	15.64	11.48	8.61	7.11	7.02	6.97
P	81.78	81.61	81.20	33.89	34.26	34.98	47.89	47.35	46.22	15.17	13.61	9.84	2.98	2.75	2.71
C	83.20	83.12	82.89	39.33	39.76	40.25	43.87	43.36	42.64	23.19	19.26	15.89	10.94	10.69	10.18
A + P (1:1)	80.10	79.98	79.59	34.89	35.42	35.87	45.21	44.56	43.72	15.84	12.78	10.28	6.75	6.70	6.68
A + C (1:1)	80.79	80.55	80.24	38.58	38.92	39.41	42.21	41.63	40.83	20.29	18.49	15.12	8.54	8.15	8.00
P + C (1:1)	81.98	81.59	81.14	36.94	37.32	37.86	45.04	44.27	43.28	22.33	18.45	15.91	7.20	7.00	6.68
A+P+C(1:1:1)	80.05	79.85	79.61	35.35	35.87	36.24	44.70	43.98	43.37	20.36	17.27	14.23	7.92	7.86	7.78
A+P+C(2:1:1)	81.01	80.90	80.14	35.61	35.98	36.46	45.40	44.92	43.68	18.78	14.11	10.36	8.01	7.59	7.45
P+A+C(2:1:1)	82.11	82.01	81.80	34.55	35.34	35.78	47.56	46.67	46.02	16.36	12.46	9.87	8.25	7.00	6.75
C+A+P (2:1:1)	80.19	80.12	79.98	38.84	39.43	39.86	41.35	40.69	40.12	19.61	17.67	13.32	9.05	8.98	8.77

Table (7): organoleptic evaluation of produced fruit sheets during storage.

Sensory parameters	Color		Taste		Odor		Texture		Overall acceptability	
Storage months / Treatments	0	9	0	9	0	9	0	9	0	9
A	9.5^{a}	8.5^{a}	9.5^{a}	8.0^{a}	9.5^{a}	8.2^{a}	8.9^{b}	7.1^{ec}	9.5^{a}	8.0^{a}
P	8.5^{c}	8.0^{b}	8.0^{d}	7.0^{b}	9.0^{b}	7.5^{cd}	8.7^{b}	7.0^{e}	8.5^{c}	7.0^{c}
C	8.0^{d}	7.3^{c}	7.5^{e}	6.8^{b}	8.0^{c}	7.0^{e}	8.0^{c}	7.3^{ec}	8.5^{c}	6.8^{c}
A + P (1:1)	9.0^{b}	8.0^{b}	9.5^{a}	8.0^{a}	8.5^{b}	7.1^{e}	8.5^{b}	7.0^{e}	9.0^{b}	8.0^{a}
A + C (1:1)	9.5^{a}	8.2^{b}	9.3^{ab}	7.9^{a}	9.5^{a}	7.9^{b}	8.5^{b}	7.0^{e}	9.5^{a}	7.9^{ab}
P + C (1:1)	8.5^{c}	7.5^{c}	8.5^{c}	7.5^{a}	9.0^{b}	7.6^{bc}	8.6^{b}	7.3^{ec}	8.5^{c}	7.5^{b}
A+P+C(1:1:1)	9.0^{b}	8.3^{ab}	9.0^{b}	7.5^{a}	9.0^{b}	7.2^{de}	8.5^{b}	7.5^{c}	9.0^{b}	7.5^{b}
A+P+C(2:1:1)	9.0^{b}	8.0^{b}	9.0^{b}	8.0^{a}	9.0^{b}	7.4^{cd}	9.5^{a}	8.2^{a}	9.0^{b}	7.9^{ab}
P+A+C(2:1:1)	9.0^{b}	8.0^{b}	9.0^{b}	8.0^{a}	9.0^{b}	7.3^{de}	9.5^{a}	8.0^{ab}	9.0^{b}	8.0^{a}
C+A+P (2:1:1)	9.0^{b}	8.0^{b}	9.0^{b}	7.8^{a}	9.0^{b}	7.2^{de}	9.0^{b}	7.7^{cb}	9.0^{b}	7.7^{ab}

Means with the same letters are not significantly different at ($p \le 0.05$)