RESULTS AND DISCUSSION

4.1 Chemical constituents of citrus juices :

Citrus squeezed juices for Balady orange, Sukary orange, mandarin, lime, sweet lemon, lemon and grapefruit were evaluated for their constituents. Data from Table (1) appeared the moisture, total soluble solids, reducing sugars, total sugars, total acidity (as citric acid), pH, vitamin C, total pectin, total free amino acids, ash, serium color, browning index, relative viscosity and caloric values.

Data from Table (1) and Figure (1) showed that the moisture percentage content was 87.82, 88.33, 88.47, 91.10, 89.51, 89.48 and 88.65 for Balady orange, Sukary orange, mandarin, lime, sweet lemon, lemon and grapefruit, respectively. These results agree with those obtained by ***Valdhuis (1971), Cohen et al., (1984)*** and ***Moustafa (1985)***, whereas total soluble solids percentage varied from juice to another for citrus juices, wherever it was 11.7%, 11.0%, 10.7%, 8.4%, 10.0%, 9.9% and 10.5% for Balady orange, Sukary orange, mandarin, lime, sweet lemon, lemon and grapefruit juices, respectively. These results are nearly similar to results obtained by ***Shomman (1974), Pennisi (1975), Nagi and Shaw (1980), Mohsen et al., (1986), Mooney et al., (1991), Sharawy (1992)*** *and* ***Noth and Sarma (1994).***

Table (1) : Chemical constituents of citrus juices

Samples / Chemical constituent	Balady Orange	Sukkary Orange	Mandarin	Lime	Sweet Lemon	Lemon	Grapefruit
Moisture %	87.62	88.35	88.47	91.10	89.58	89.48	88.65
Total soluble solids %	11.7	11.0	10.7	8.4	10.0	9.9	10.5
Reducing sugars %	5.13	5.21	4.73	1.28	1.35	2.05	4.17
Total sugars %	9.83	9.77	8.95	1.29	8.73	2.65	7.16
Total acidity *	1.35	0.92	0.98	6.73	0.91	4.41	2.13
pH value	3.7	3.9	3.9	2.2	3.4	2.5	3.5
Ascorbic acid (mg/100g)	54.23	52.93	47.32	43.19	45.31	51.28	43.56
Carotenoids (mg/100g)	2.525	2.451	1.1546	1.162	1.053	1.264	3.255
Total pectin (mg/100g)	55.57	52.73	37.89	34.31	31.42	38.62	41.75
Formol number (mg/100g)	25.91	26.95,	27.13	25.33	22.42	33.49	26.78
Ash content %	0.473	0.534	0.750	0.463	0.491	0.732	0.625
Serium color **	88.9	85.7	73.8	91.6	92.7	91.3	79.3
Browning index ***	0.038	0.031	0.062	0.011	0.014	0.025	0.046
Relative viscosity	1.676	1.568	1.644	1.428	1.344	1.332	1.508
K.calory/100 ml	44	43	39	12	38	16	32

* Calculated as citric acid

** As transmission % (420 nm)

*** As Optical density (420 nm)

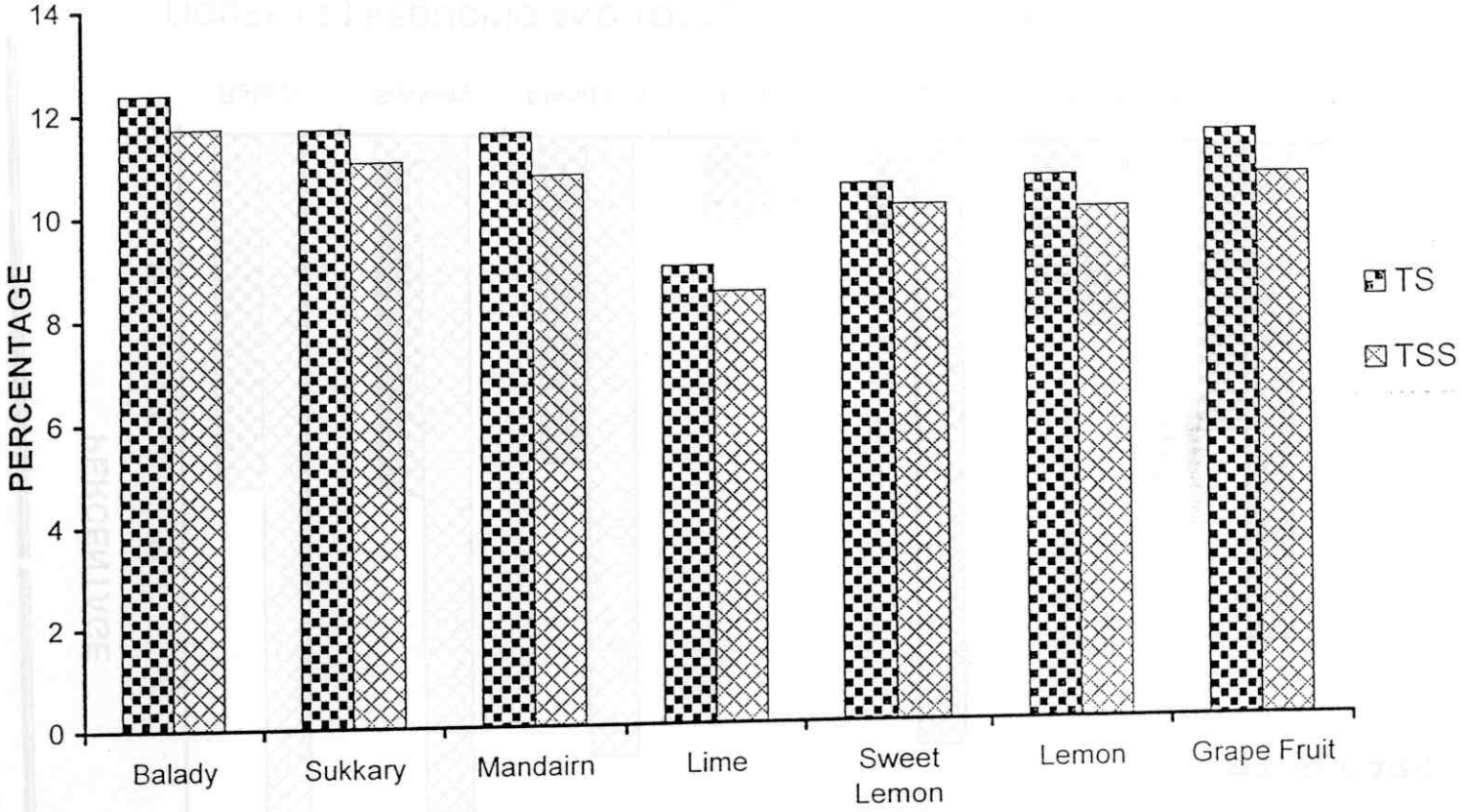


FIGURE (1) : TOTAL SOLIDS AND TOTAL SOLUBLE SOLIDS PERCENTAGE FOR DIFFERENT CITRUS JUICES.

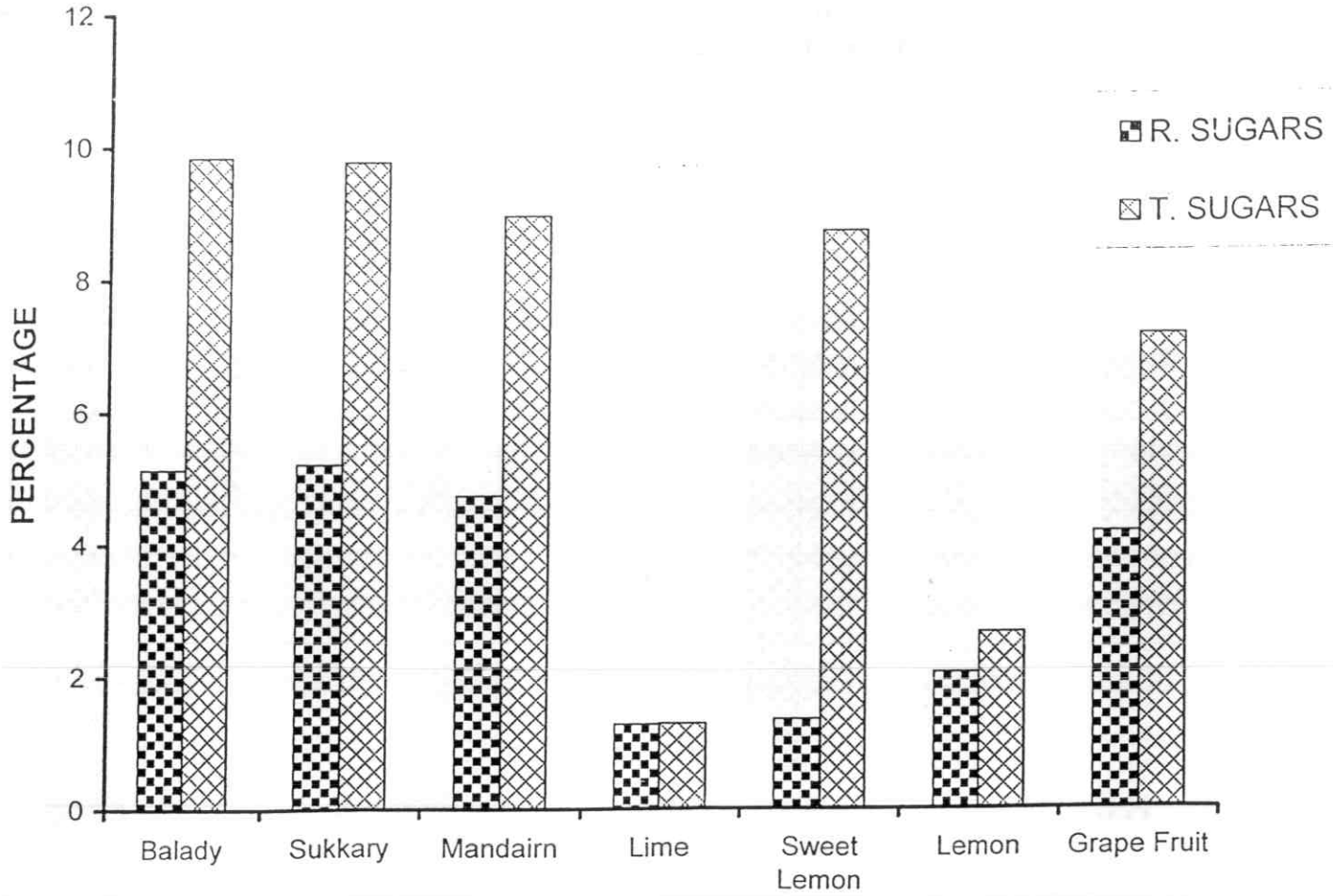


FIGURE (2) REDUCING AND TOTAL SUGARS PRECENTAGE FOR DIFFERENT CITRUS JUICES.

Table (1) and Figure (2) showed the results of reducing sugars and total sugars for different citrus juices. The reducing sugars and total sugars were 5.13% & 9.83%, 5.21% & 9.77%, 4.73% & 8.95%, 1.28% & 1.29%, 1.35% & 8.73%, 2.05% & 2.65% and 4.17% & 7.16% for Balady orange, Sukary orange, lime, sweet lemon, lemon and grapefruit, respectively. These results are in agreement with those obtained by ***El-Hashimy et al., (1986), El-Deeb (1990), Widmer (1990), and Noth and Sarma (1994).***

Concerning total acidity (as citric acid) and pH values, Table (1) and Figure (3) showed that the variation of acidity in citrus juices, while acidity is higher in lime and lemon it is lower in Sukary orange and mandarin. Results showed that the acidity as citric acid was 1.35%, 0.92%, 0.98%, 6.73%, 0.91%, 4.41% and 2.13% for Balady orange, sukary orange, mandarin, lime, sweet lemon, lemon and grapefruit, respectively. On the contrary, pH values are lower when acidity is higher, so the data showed that the pH values were 3.7, 3.9, 3.9, 2.8, 3.4, 2.5 and 3.5 for Balady orange, Sukary orange, mandarin, lime, sweet lemon, lemon and grapefruit, respectively. These results were similar to the results obtained by ***Shomman(1974), Abd El-Fadeel (1978), robertson and Nisperos*** *(1983),* ***Peccolo et al., (1983), Sharawy (1992)*** *and* ***Noth and Sarma (1994).***

Ascorbic acid and total carotenoids results are presented in Table (1) and Figure (4), citrus juices are a main source of vitamin C and contain a suitable amount of carotenoids (provitamin A).

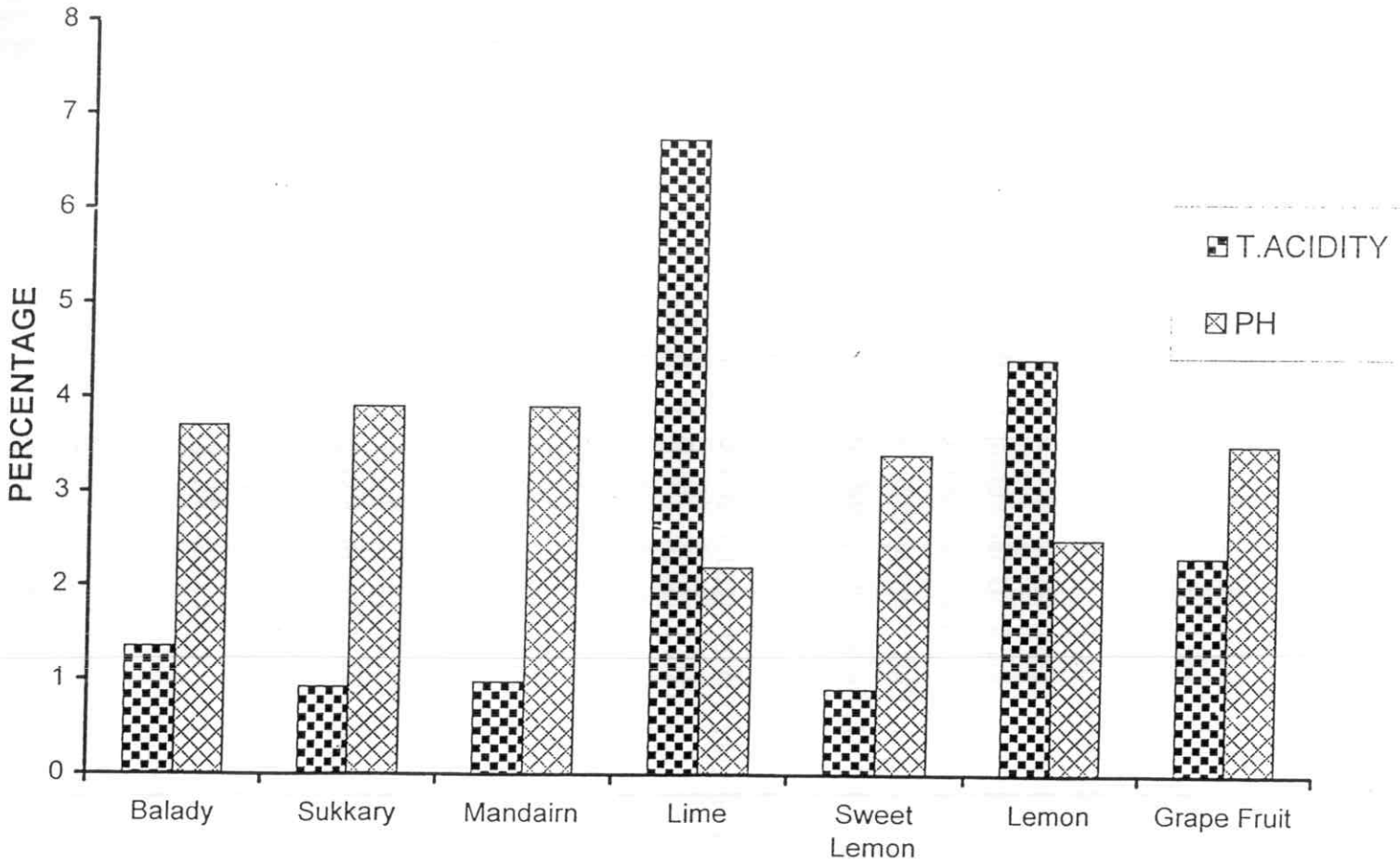


FIGURE (3) : TOTAL ACIDITY PERCENTAGE AND PH VALUE FOR DIFFERENT CITRUS JUICES.

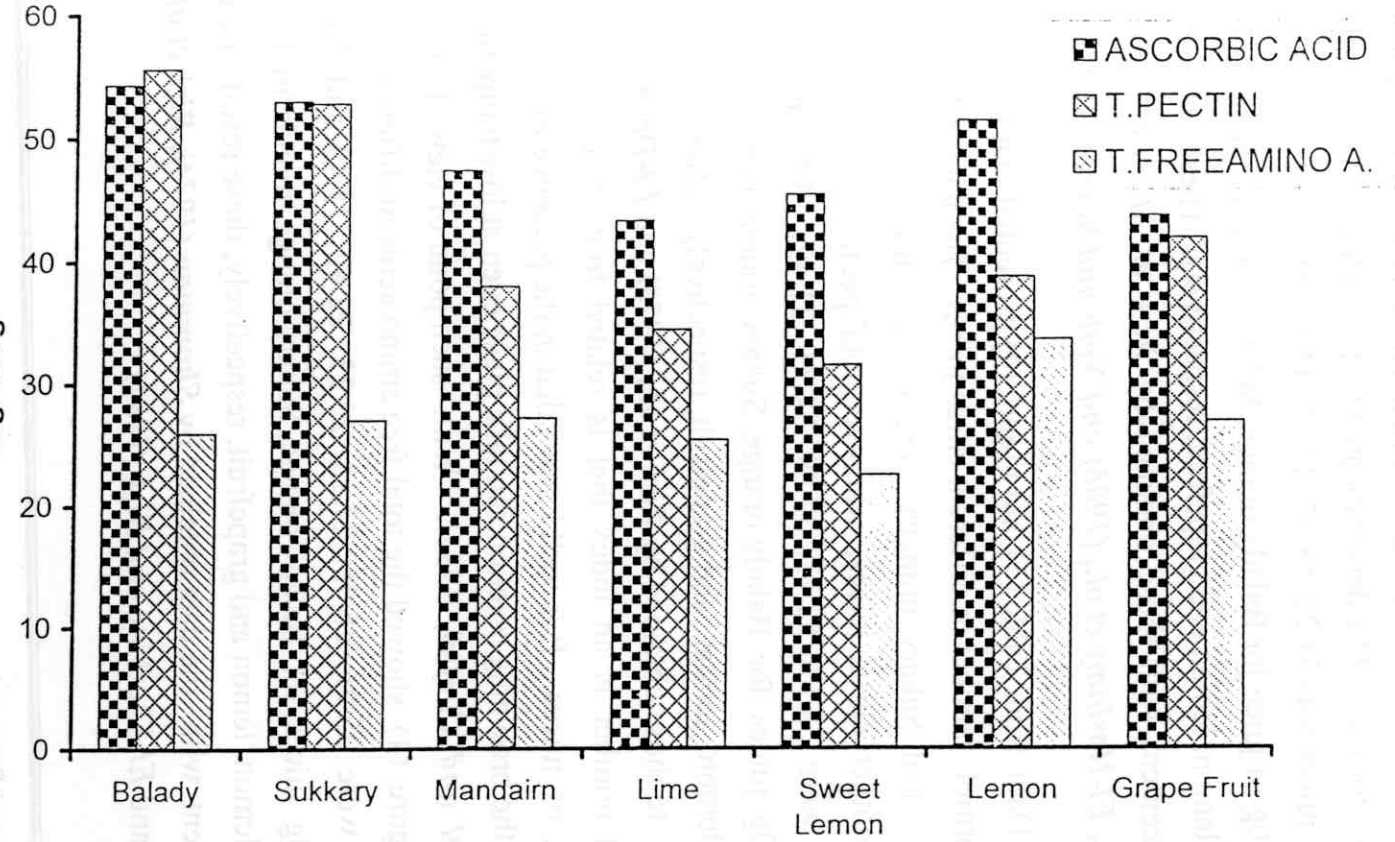


FIGURE (4) : ASCORBIC ACID, TOTAL PECTIN AND TOTAL FREE AMINO ACID (mg/100 g) FOR DIFFERENT CITRUS JUICES

ascorbic acid is an important nutrient and very likely to decompose during storage. The data indicated that ascorbic acid (mg/100g) in citrus juices was 54.23, 58.93, 47.32, 43.19, 45.31, 51.28 and 43.56 mg/100g of juice for Balady orange, Sukary orange, mandarin, lime, sweet lemon, lemon and grapefruit, respectively. These results were in agreement with those obtained by ***Rizk et al., (1978), Samar (1985), El-Hashimy et al., (1986) and Noth and Sarma (1994).***

Data from Table (1) and Figure (4) presented that total pectin and formol number in different citrus juices. The data indicate that Balady and Sukary oranges were relatively higher pectin content than another citrus juices, wherever, total pectin in different citrus juices were 55.57, 52.73, 37.89, 34.31, 31.42, 38.62 and 41.75 mg/100g juices for Balady orange, Sukary orange, mandarin, lime, sweet lemon, lemon and grapefruit, respectively. These data were similar to those obtained by ***Rizk et al., (1978)*** and ***El-Deeb (1990)***. Formol number is an index that is related to the free amino acid content of juices. It is well known that in the presence of reducing sugars the browning reaction can take place even at low temperature ***(Cheftel and Cheftel, 1984)***. With such point of view, Table (1) and Figure (4) showed the total free amino acids of different citrus juices were 25.91, 26.95, 27.13, 25.33, 22.42, 33.49 and 36.78 mg/100g juices for Balady orange, Sukary orange, mandarin, lime, sweet lemon, lemon and grapefruit, respectively, these results are in agreement with the data obtained by ***Shomman (1974), Rizk et al., (1978)*** and ***El-Sherbiny and Rizk (1981)***.

Data from Table (1) and Figure (5) showed that total carotenoids in citrus juices was 25.25, 24.51, 115.46, 11.62, 10.53, 12.64 and 32.55 mg/100g juice for Balady orange, Sukary orange, mandarin, lime, sweet lemon, lemon and grapefruit, respectively. These results were in agreement with those obtained by ***Rizk et al., (1978).*** It could be concluded that mandarin is higher content from total carotenoids whereas sweet lemon, lime and lemon were lower content from total carotenoids.

Ash percentage was tabulated in Table (1) and Figure (6) wherever, the ash content of different citrus juices were 0.473%, 0.534%, 0.750%, 0.463%, 0.491%, 0.732% and 0.625%, respectively, these figures are similar with those obtained by ***Habiba (1982), Cohen et al., (1984), Piccolo et al., (1985) and El-Deeb (1990).***

Serium color is an important visual attribute of citrus juices. The higher the percent transmission, the lower and less desirable the cloud. The available data given in Table (1) and Figure (7), results showed that the transmission percentage of citrus juices serium was 88.9%, 85.7%, 73.8%, 91.6%, 92.7%, 91.3% and 79.3% for Balady orange, Sukary orange, mandarin, lime, sweet lemon, lemon and grapefruit, respectively.

Browning index of citrus juices showed a varied changes. Data presented in Table (1) and Figure (8) showed that the optical density was 0.038, 0.031, 0.062, 0.011, 0.014, 0.025 and 0.046 for Balady orange, Sukary orange, mandarin, lime, sweet lemon, lemon and grapefruit, respectively.

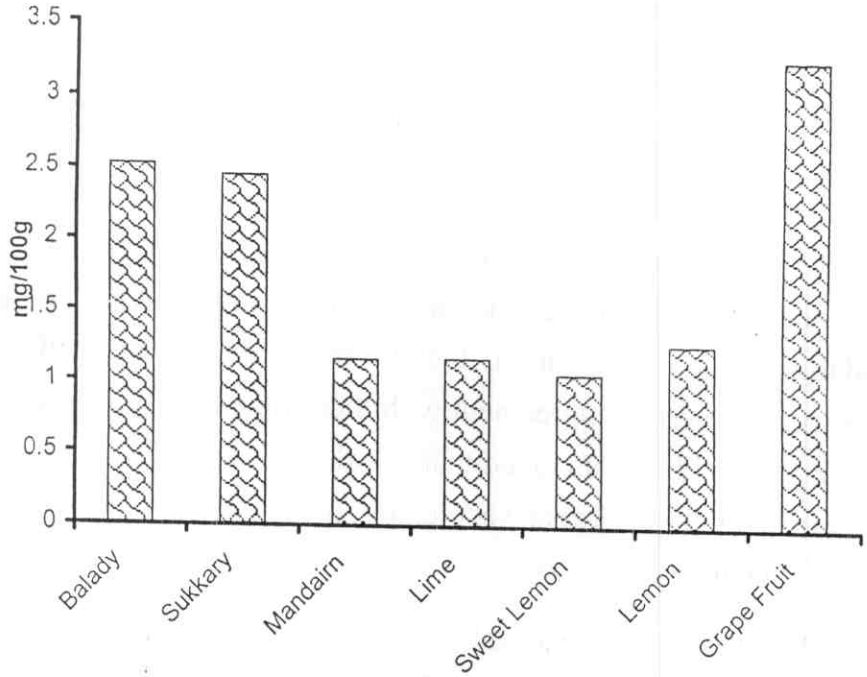


FIGURE (5) : TOTAL CAROTENOIDS (mg/100 g) FOR DIFFERENT CITRUS JUICES .

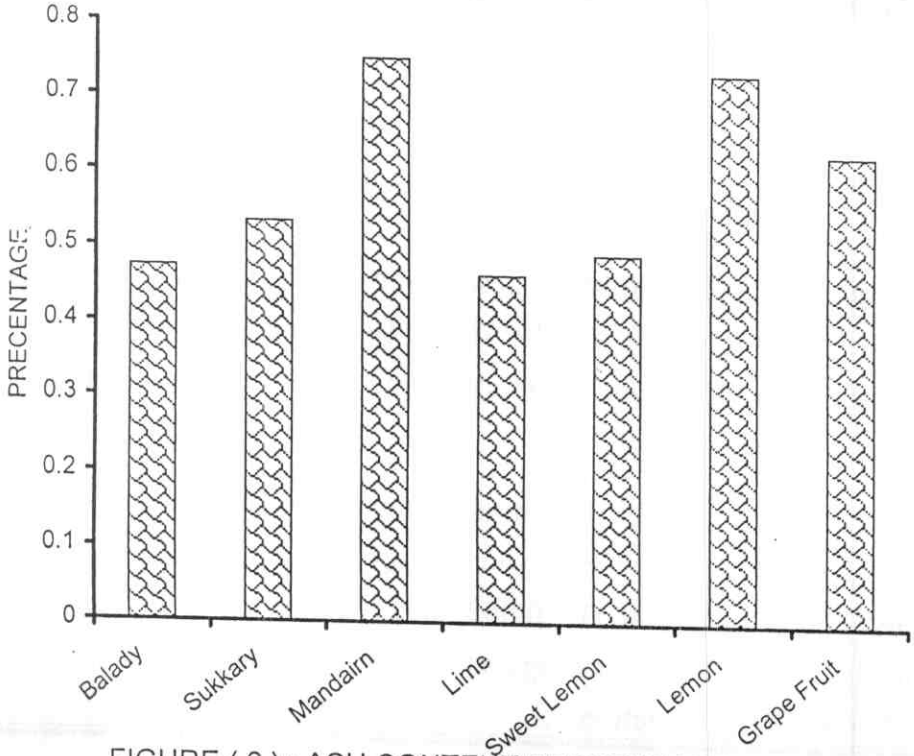


FIGURE (6) : ASH CONTENT PERCENTAGE FOR DIFFERENT CITRUS JUICES

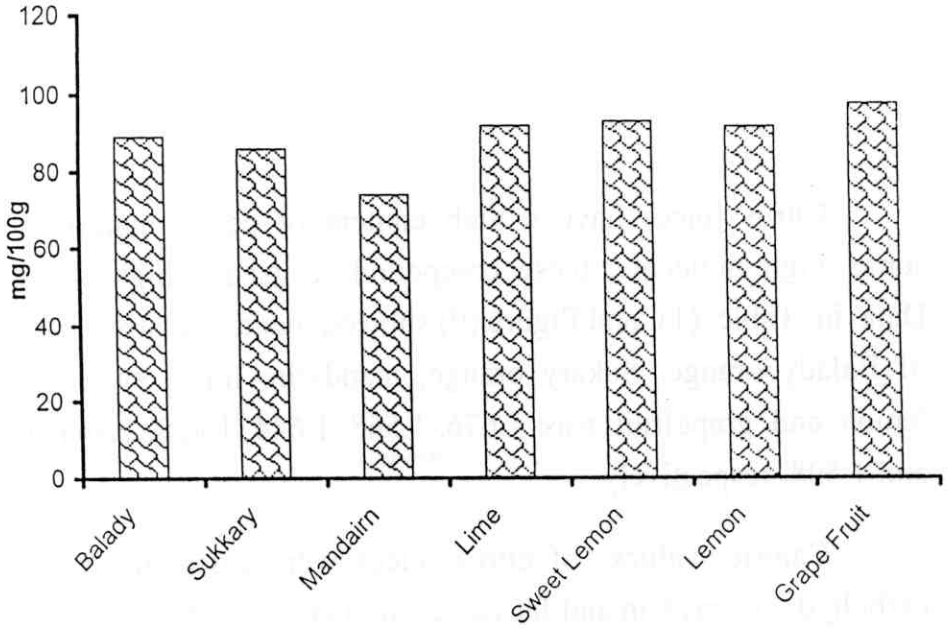


FIGURE (7) :SERIUM COLOR (TRANS. AT 420 nm) FOR DIFFERENT CITRUS JUICES.

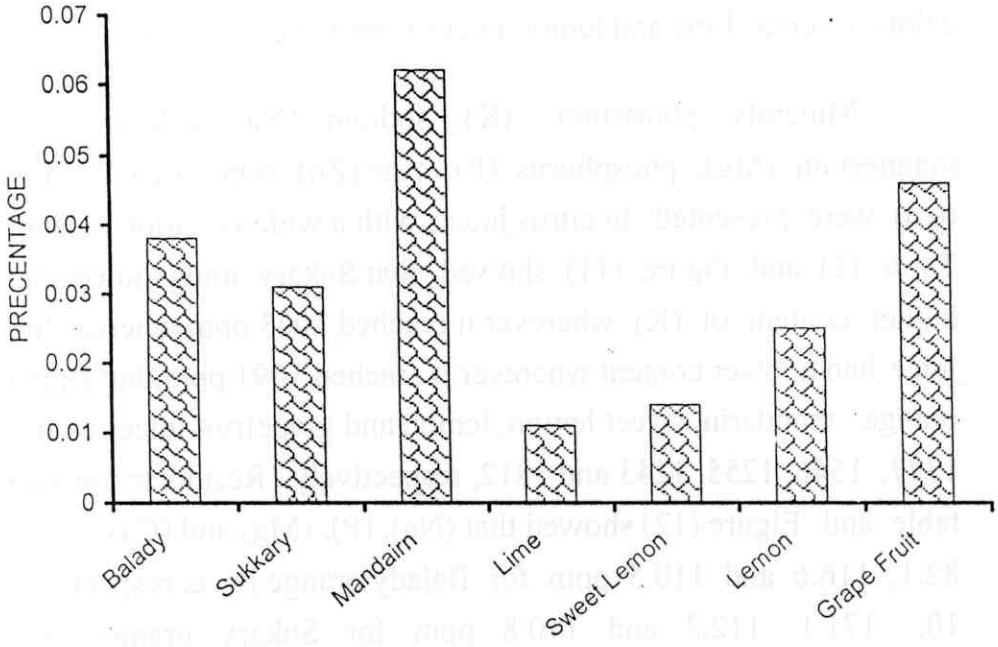


FIGURE (8) :BROWNING INDEX (O.D AT 420 nm) FOR DIFERENT CITRUS JUICES.

Citrus juices have a high content of pectic materials and some high molecule, these compounds caused a high viscosity. Data in Table (1) and Figure (9) showed that the relative viscosity of Balady orange, Sukary orange, mandarin, lime, sweet lemon, lemon and grapefruit was 1.676, 1.568, 1.644, 1.428, 1.344, 1.332 and 1.508, respectively.

Caloric values of citrus juices were calculated from the carbohydrate, protein and fat values in juices. So, the caloric values were 44, 43, 39, 12, 38, 16 and 32 kilocalory for Balady orange, Sukary orange, mandarin, lime, sweet lemon, lemon and grapefruit, respectively, Table (1) and Figure (10). From the data it could be concluded that Balady and Sukary orange juices were higher in calory whereas lime and lemon juices were lower in calory.

Minerals potassium (K), sodium (Na), calcium (Ca), magnesium (Mg), phosphorus (P), zinc (Zn), iron (Fe) and copper (Cu) were presented in citrus juices with a wide variation. Data in Table (2) and Figure (11) showed that Sukary orange juice had a higher content of (K) wherever it reached 2003 ppm whereas lime juice had a lower content wherever it reached 1091 ppm, but Balady orange, mandarin, sweet lemon, lemon and grapefruit juices contain 1327, 1546, 1255, 1243 and 1812, respectively. Results in the same table and Figure (12) showed that (Na), (P), (Mg) and (Ca) was 17, 82.1, 116.6 and 110.5 ppm for Balady orange juice, respectively, 10, 171.1, 112.2 and 110.8 ppm for Sukary orange juice, respectively, 30.5, 98.7, 115.7 and 126.9 ppm for mandarin juice, respectively, 10, 72.1, 60.5 and 91.3 ppm for lime juice,

respectively, 10.8, 63.2, 62.7 and 72.1 ppm for sweet lemon, respectively, 10.5, 62.5, 61.3 and 71.2 ppm for lemon juice, respectively and 11.1, 164.1, 115.0 and 101.6 ppm for grapefruit juice, respectively. Whereas, the same table and Figure (13) showed that (Fe), (Zn) and (Cu) was 2.01, 0.5, 0.44 ppm for Balady orange juice, respectively, 1.98, 0.51, 0.45 ppm for Sukary orange juice, respectively, 2.05, 0.49, 0.46 ppm for mandarin juice, respectively, 0.33, 0.61, 0.31 ppm for lime juice, respectively, 0.31, 0.5, 0.3 ppm for sweet lemon juice, respectively, 0.34, 0.49, 0.29 ppm for lemon juice, respectively, 0.22, 0.48, 0.32 ppm for grapefruit juice, respectively. These results are in agreement with those obtained by ***Gloppiol et al., (1974), Royo and Gimenez (1974), Royo and Pauletti (1976)*** *and* ***Cohen et al., (1984)***.

4.2 Chemical constituents of fresh citrus blend juice and citrus blend drink for sports :

Fresh citrus blend juice which is mixture of Balady orange, Sukary orange, mandarin, lime, sweet lemon, lemon and grapefruit juices with percentage of 32.5%, 24%, 13.5%, 16.5%, 4%, 4% and 5.5%, respectively, this blend was diluted with water (1:1 v/v), 20% natural sugars for control and different amounts of sugars, 5% sweet condensed milk, 10% honey and a minor amount of mineral salts and vitamins for treatments A, B and C.

Table (2) : Mineral content (mg/100g) in citrus fruit juices

Samples / Minerals	Balady Orange	Sukkary Orange	Mandarin	Lime	Sweet Lemon	Lemon	Grapefruit
Sodium	1.70	1.00	3.05	1.00	1.02	1.05	1.11
Potassium	132.7	200.3	154.6	109.1	125.5	124.3	181.2
Phosphorus	8.21	17.11	9.87	7.21	6.32	6.25	16.41
Magnesium	11.66	11.22	11.57	6.05	6.27	6.13	11.50
Zinc	0.050	0.051	0.049	0.061	0.050	0.049	0.048
Copper	0.044	0.045	0.046	0.031	0.030	0.029	0.032
Calcium	11.05	11.08	12.69	9.13	7.21	7.12	10.16
Iron	0.201	0.198	0.205	0.033	0.031	0.034	0.022

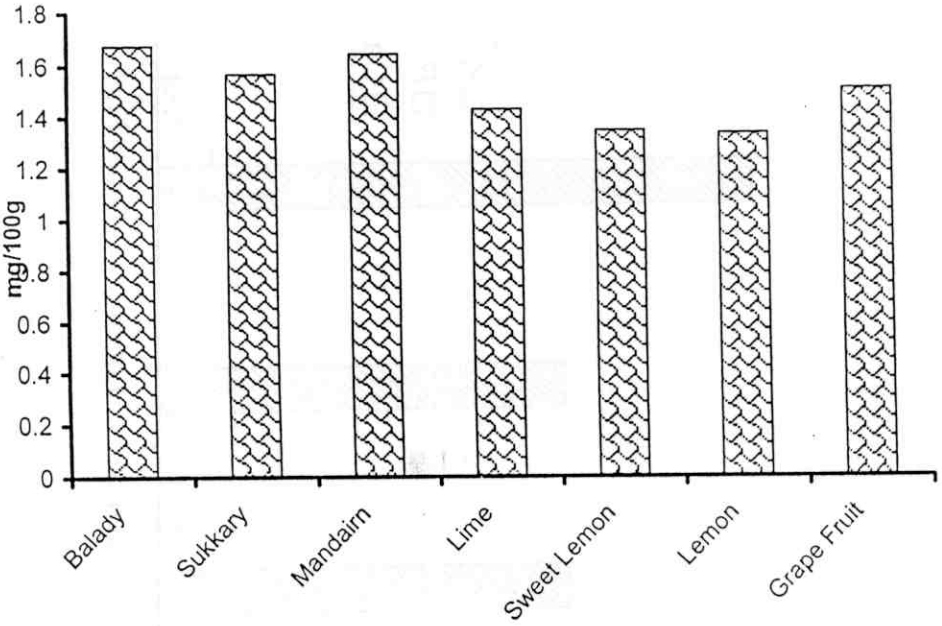


FIGURE (9): RELATIVE VISCOSITY FOR DIFFERENT CITRUS JUICES.

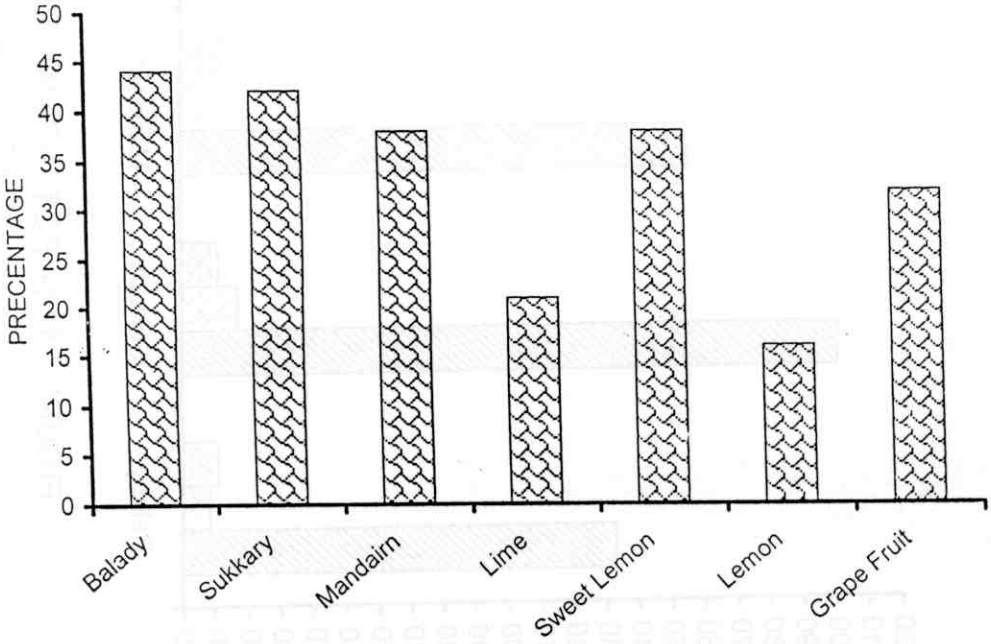


FIGURE (10) :KILO CALORY CONTENT PER 100ml FOR DIFFERENT CITRUS JUICES.

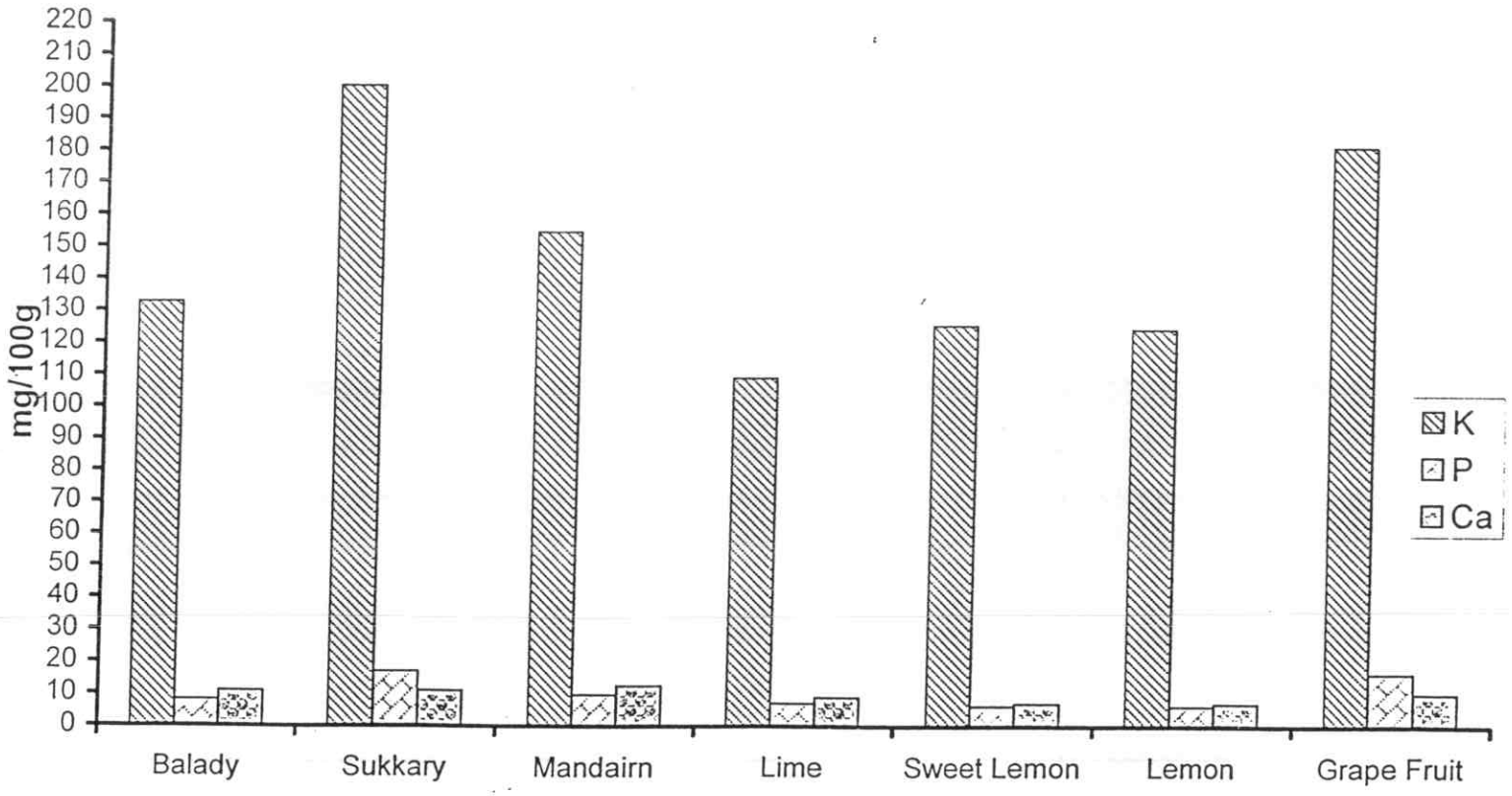


FIGURE (11) : POTASSIUM , PHOSPHORUS AND CALCIUM FOR DIFFERENT CITRUS JUICES .

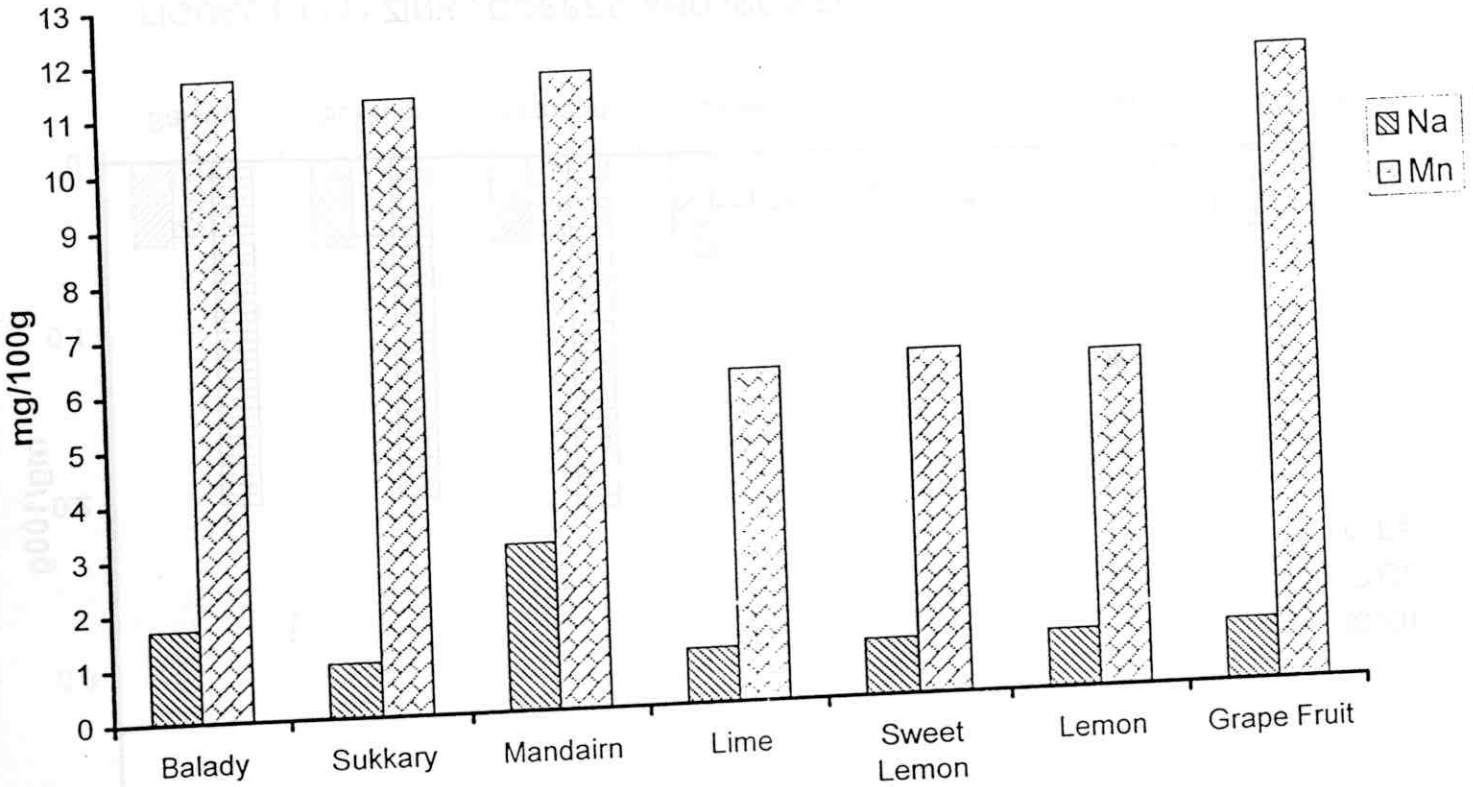


FIGURE (12) : SODIUM AND MAGNESIUM FOR DIFFERENT CITRUS JUICES

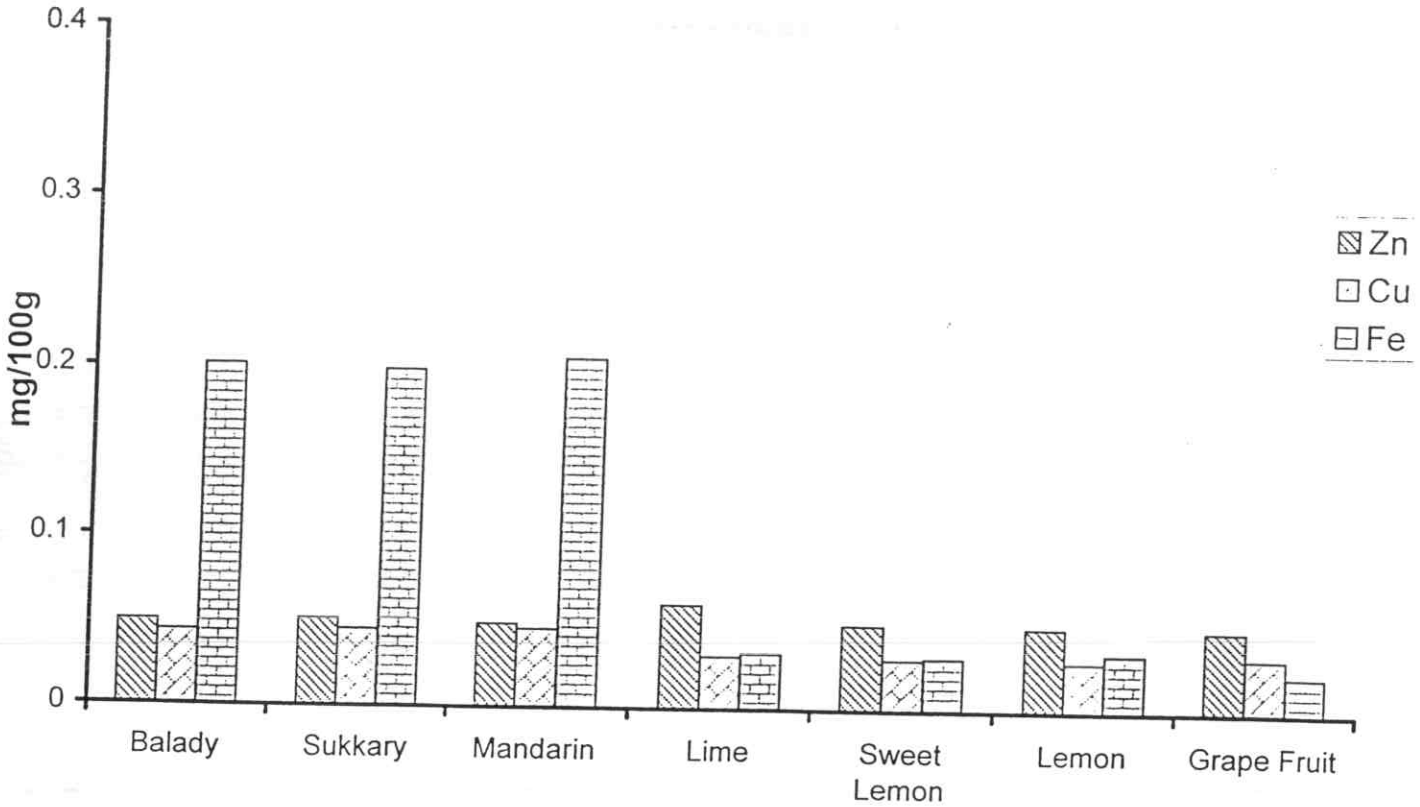


FIGURE (13) : ZINK , COPPER AND IRON FOR DUFFERENT CITRUS JUICES .

Water is very important for sports, so the best source of water is natural drinks especially if contained sugars for energy as well as vitamins and minerals. Data in Table (3) and Figure (14) showed the total solids content of fresh citrus blend juice and citrus blend sport drink treatments, the moisture was 88.93%, 73.95%, 73.08%, 72.75% and 73.03% for fresh citrus blend juice, control of citrus sport drink, sport drink (A), sport drink (B) and sport drink (C), respectively. It could be noticed that fresh citrus blend juice had higher water than that control treatment and citrus drink treatments, this due to additive solid contents (sugars, honey, milk with mineral salts) which was mixed with diluted citrus blend juice.

Most of solids in citrus blend juices are soluble solids, the soluble solids in juice mainly sugars, organic acids, minerals and some vitamins. The experimental data in Table (3) and Figure (14) showed that total soluble solids of fresh citrus blend juice was 10.6%, this juice was diluted with water (1:1 v/v), so the total soluble solids reduced to ~ 5% the soluble solids of drinks were raised in different treatments to 25.4%, 26.2%, 26.5% and 26.3% for control sport drink, treatment A, sport drink treatment B and sport drink treatment C, respectively. The raise of total solids was carried by adding natural sugars, honey, condensed sweet milk and minor amount of soluble salts and vitamins.

Total sugars including reducing sugar represent the major constituents of total soluble solid in citrus blend juice. Table (3) and Figure (15) represents the reducing sugar and total sugars in fresh citrus blend juice and sports drink treatments.

Table (3) : Chemical and physical properties of fresh citrus blend juice and citrus blend drink for sports

	Fresh citrus blend juice	Citrus blend drink treatments			
		Control	A	B	C
Moisture %	88.93	73.95	73.08	72.75	73.03
Total soluble solids %	10.6	25.4	26.2	26.5	26.3
Reducing sugars %	2.67	2.86	11.18	21.43	19.17
Total sugars %	5.01	24.13	24.75	24.86	24.69
Acidity (as citric acid)	2.138	1.069	1.121	1.128	1.125
pH value	3.60	3.78	3.86	3.81	3.84
Vitamin C (mg/100g)	49.45	26.12	68.32	68.45	68.38
Total carotenoids (mg/100g)	3.372	1.625	1.586	1.592	1.578
Total pectin (mg/100g)	46.15	22.92	23.17	23.25	23.11
Total free amino acid (mg/100g)	36.22	19.15	24.53	24.69	24.60
Ash content %	0.5401	0.2692	0.3125	0.3212	0.3151
Serium color (Trons. 420 nm)	86.5	93.2	82.3	81.7	82.0
Browning index (O.D. 420 nm)	0.043	0.022	0.038	0.040	0.040
Relative viscosity	1.585	1.602	1.617	1.625	1.615
K.calory/100cc	26	110	119	120	122

Control : Citrus blend drink with 20% sucrose
A : Citrus blend drink with 10% sucrose, 5% sweet condensed milk and 10% honey
B : Citrus blend drink with 5% glucose, 5% fructose, 5% sweet condensed milk and 10% honey.
C : Citrus blend drink with 2.5% sucrose, 5% glucose, 2.5% fructose, 5% sweet condensed milk and 10% honey

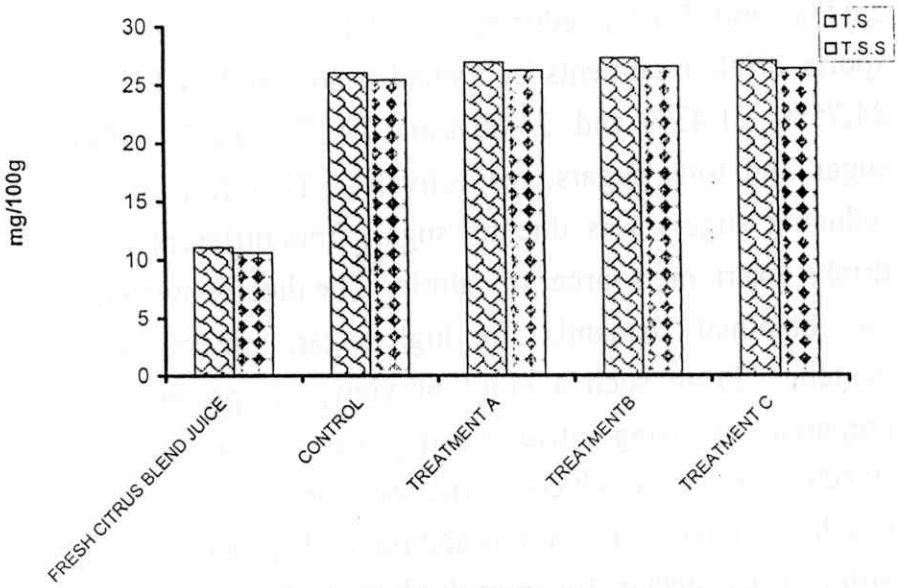


FIGURE (14):TOTAL SOLID AND TOTAL SOLUBLE SOLIDS OF FRESH CITRUS BLEND JUICES AND DRINK TREATMENTS FOR SPORTS

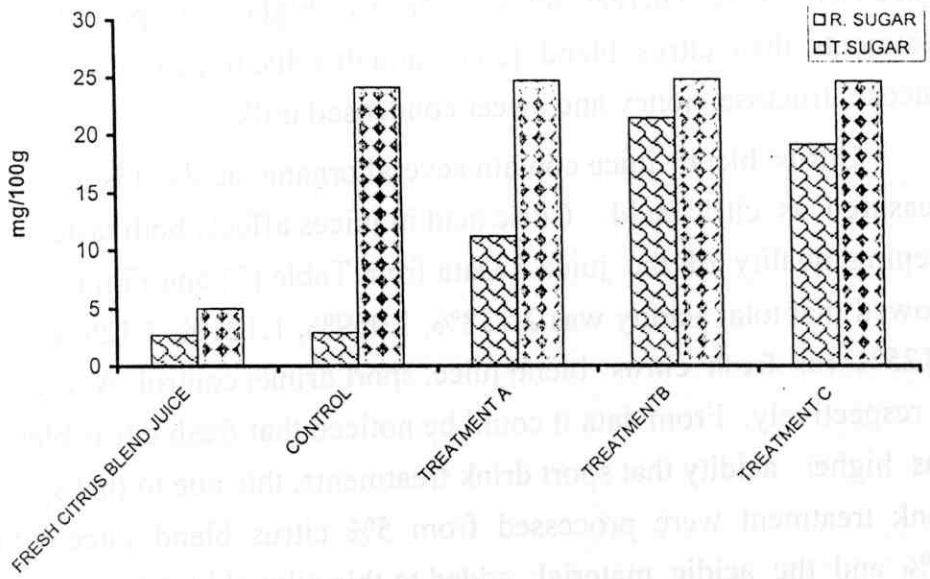


FIGURE (15):REDUCING AND TOTAL SUGARS OF FRESH CITRUS BLEND JUICES AND DRINK TREATMENTS FOR SPORTS .

It could be noticed that the fresh citrus blend juice contained 2.67% and 5.01% reducing and total sugars, respectively. But sports drink treatments contained 2.86% and 24.13%, 11.18% and 24.75%, 21.43% and 24.86% and 19.17% and 24.69% of reducing sugar and total sugars, respectively. Therefore, the variation in reducing sugars was due to sugars from different sources in sport drinks exert on source of calorie. The dietary awareness of sports has obtained demands for high sugar, mineral, vitamin, water content. From such a point of view, the present samples were prepared by using citrus blend juices and a source or more of sweetner (sucrose, glucose, fructose, honey, sweet condensed milk) besides sources for vitamins and minerals (honey, sweet condensed milk, citrus nectar) for sport drink control, sport drink treatment A, sport drink treatment B and sport drink treatment C. Adding glucose and fructose besides reducing sugar in honey and sweet condensed milk, whereas total sugar was higher in sport drinks treatments than citrus blend juice, and this due to adding sucrose, glucose, fructose, honey and sweet condensed milk.

Citrus blend juice contain several organic acids, it is usually measured as citric acid. Citric acid in juices affects both taste and keeping quality of the juice. Data from Table (3) and Figure (16) showed that total acidity was 2.138%, 1.069%, 1.121%, 1.129% and 1.125% for fresh citrus blend juice, sport drinks control, A, B and C, respectively. From data it could be noticed that fresh citrus blend was higher acidity that sport drink treatments, this due to that sport drink treatment were processed from 5% citrus blend juice with 50% and the acidic material added to this diluted blend juice was

small amount (ascorbic acid, organic acids in honey and sweet condensed milk). On the contrary, pH values were increase by decrease total acidity, as shown in Table (3) and Figure (16) therefore pH of citrus blend juice, sport drink treatments control, A, B and C was 3.6, 3.78, 3.86, 3.81 and 3.84, respectively.

Carotenoids constituents are the major coloring material in citrus juice. The oxidation of these pigments leads to the daffing of the color and thus affecting the acceptability and quality of the juice. Besides, the oxidation of such pigments might affect the nutritive value of the juice. In this study, the carotenoids in the citrus blend drinks were 3.372 mg/100g, 1.625 mg/100g, 1.586 mg/100g, 1.592 mg/100g and 1.578 mg/100g for fresh citrus blend juice, citrus drink control, citrus drink treatment A, citrus drink treatment B and citrus drink treatment C, respectively (Table (3) and Figure (17)). From this data it could be concluded that citrus blend juice was higher content in carotenoids than another drink treatment this due to the dilution of citrus blend juice with water (1:1 v/v), and reduce the carotenoids content to ~ 50%.

Ascorbic acid is one of the most nutrients in fruit juices, citrus fruit juices is a best source of ascorbic acid. The data in Table (3) and Figure (18) indicated that citrus blend juices contain 49.45 mg/100g whereas after blend with water to prepare control sport drink, sport drink contain 26.12 mg/100g. Because sports needs more vitamin C, the diluted citrus blend with water fortified with a vitamin C and a minor amount from honey, so sport drinks treatment A contain 68.32 mg/100g, treatment B contain 68.45 mg/100g and treatment C contain 68.38 mg/100g.

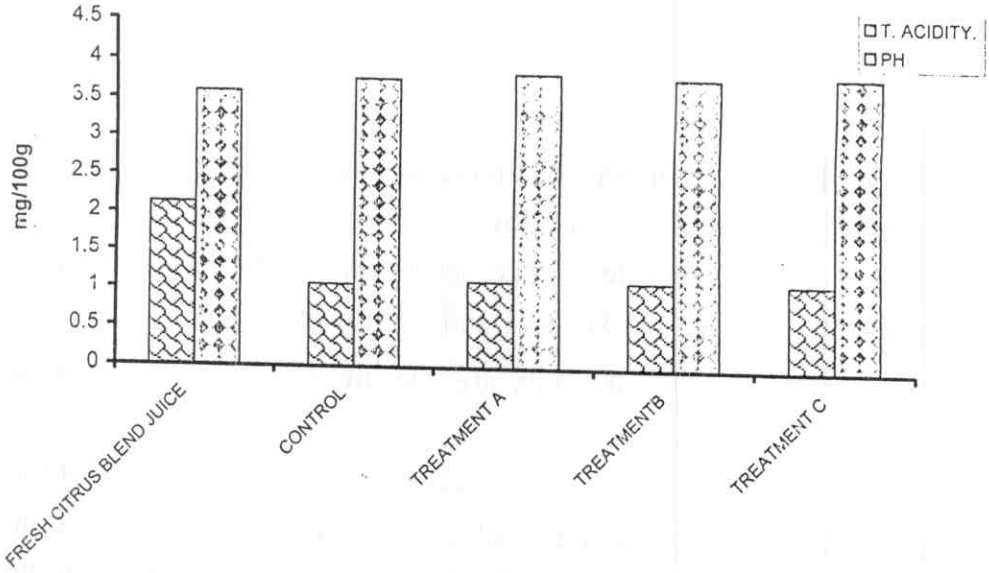


FIGURE (16):TOTAL ACIDITY AND PH VALUE OF FRESH CITRUS BLEND JUICES AND DRINK TREATMENTS FOR SPORTS

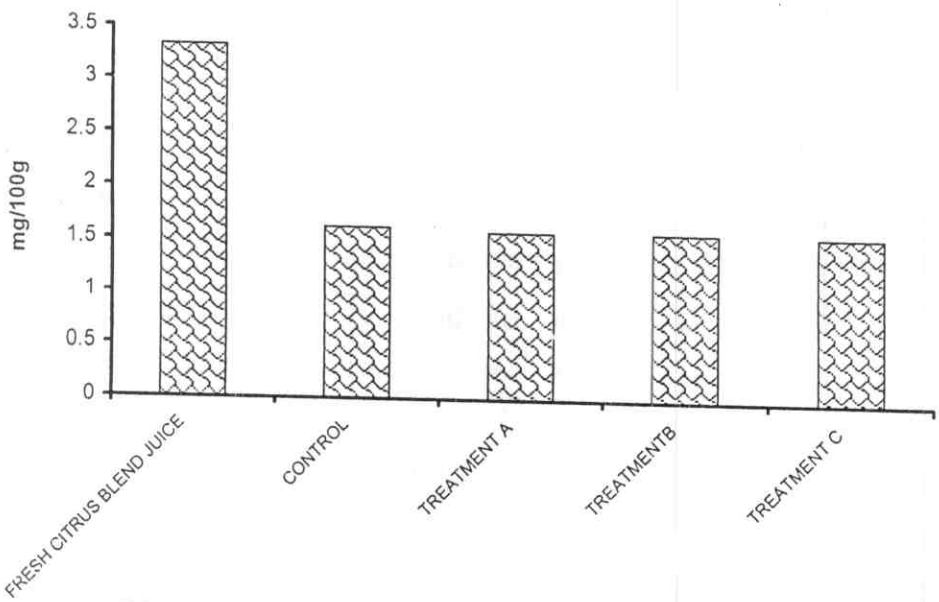


FIGURE (17):TOTAL CAROTENOIDES (mg/100g) OF FRESH CITRUS BLEND JUICES AND DRINK TREATMENTS FOR SPORTS .

Pectic substances which play an important role in increasing the consistency of citrus juice were determined as total pectin. Results in Table (3) and Figure (18) showed that total pectin was 46.15 mg/100g in fresh citrus blend juice, whereas total pectin reduced to 22.92 mg/100g, 23.17 mg/100g, 23.25 mg/100g and 23.11 mg/100g for control sport drink, citrus sport drink treatment A, citrus sport drink treatment B and citrus sport drink treatment C, respectively, this due to during processing the fresh citrus blend juice was blended with water (1:1 v/v).

Formol number is indicated to total free amino acid, data in Table (3) and Figure (18) indicated that the total free amino acids was higher in citrus blend juice followed by citrus sport drink treatments than that in control citrus drink treatment whereas it was 36.22 mg/100g, 19.15 mg/100g, 24.53 mg/100g, 24.69 mg/100g and 24.60 mg/100g for fresh citrus blend juice, citrus drink treatment control, citrus drink treatment A, citrus drink treatment B and citrus drink treatment C, respectively. This due to that during processing the citrus blend juice was diluted with water (1:1 v/v) and sweetened with sucrose in control treatments, but in citrus drink treatments was sweetened with sugars besides adding honey and sweet condensed milk which were reach in free amino acids.

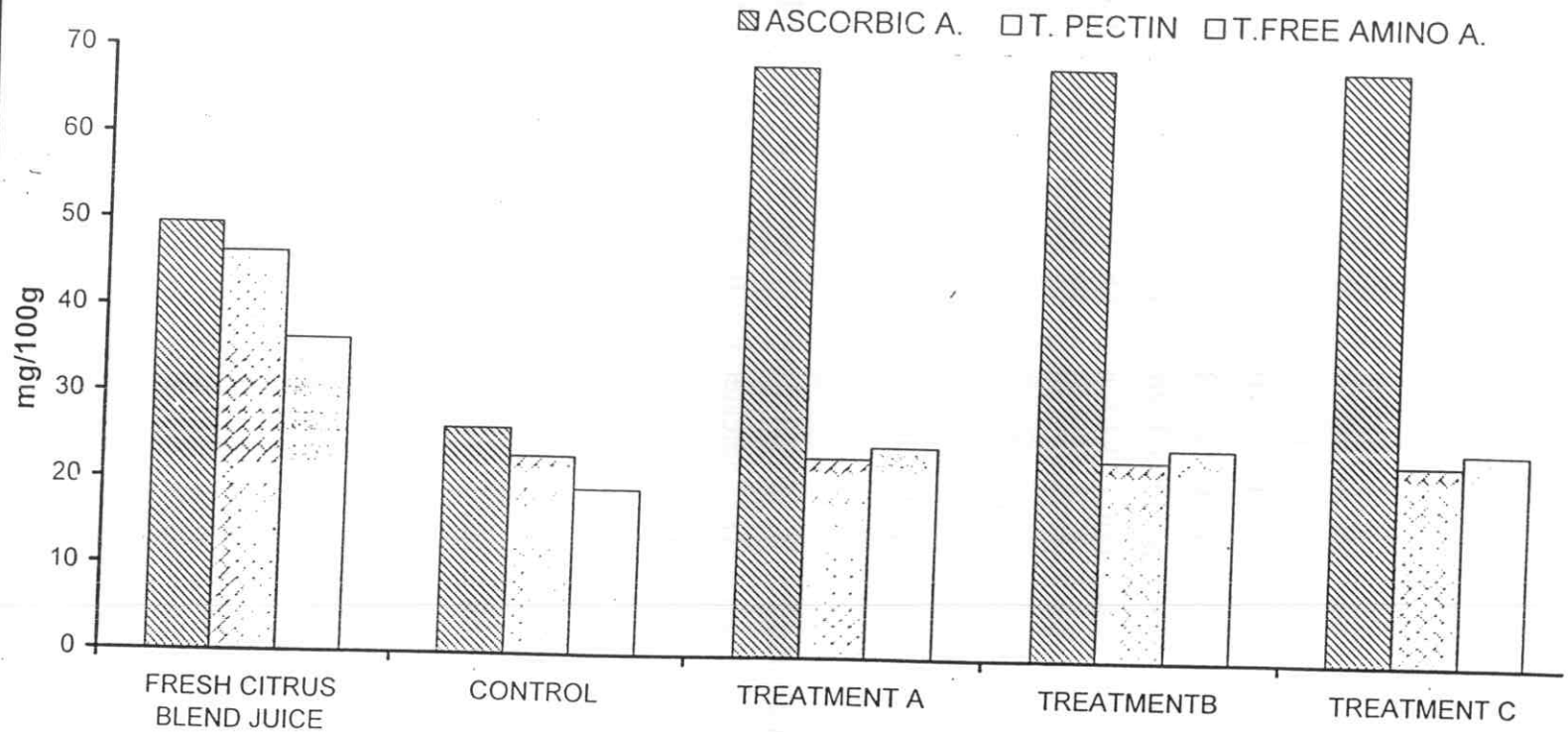


FIGURE (18) ASCORBIC ACID , TOTAL PECTIN AND TOTAL FREE AMINO ACID (mg/100g) OF FRESH CITRUE BLEND JUICES AND CITRUS BLEND DRINK TREATMENTS FOR SPORTS .

Data presented in Table (3) and Figure (19) showed that ash content in fresh citrus blend juice was 0.5401%, it reduced to 22.92% in control of citrus drink which diluted with water (1:1 v/v) and sweetened with sucrose, whereas it raise than control but less than citrus blend juice because diluted blend juice with water was mixed with sugars, sweet condensed milk and honey which contain a small amount of ash.

Data indicated that citrus drink control, citrus drink treatment A, citrus drink treatment B and citrus drink treatment C contained 0.2692%, 0.3125%, 0.3212% and 0.3151%, respectively.

Serium color of citrus juices and citrus drinks indicated the degree of small particles suspended in serium. Data from Table (3) and Figure (20) showed that the serium color measure as transmission at 420 nm was 86.5% for fresh citrus blend juice raised to 93.2% for control of citrus drink treatment because it diluted by water by a ratio 1:1 v/v and sweetened with sucrose, whereas in citrus drink treatment A, citrus drink treatment B and citrus drink treatment C was 82.3%, 81.7% and 82.0%, respectively, this results due to the small particles suspended in serium from sweet condensed milk and honey.

Color of citrus drink is an important quality factor, carotenoids mainly in citrus are responsible for yellow color in drinks. The color of citrus drink changes from acceptable yellow to rejected brownish which is mainly due to enzymatic browning reaction.

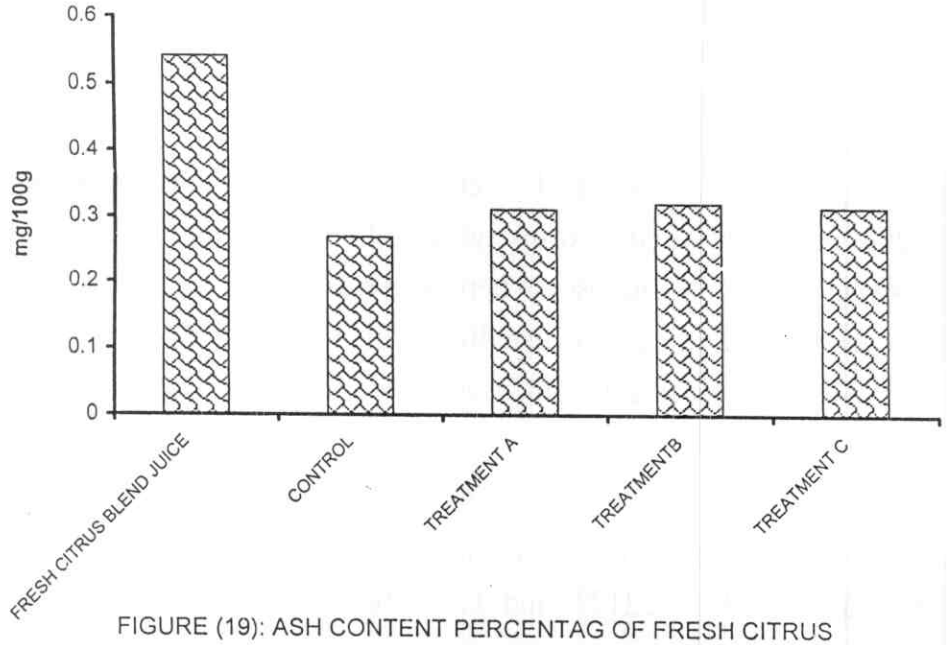


FIGURE (19): ASH CONTENT PERCENTAG OF FRESH CITRUS BLEND JUICES AND DRINK TREATMENTS FOR SPORTS .

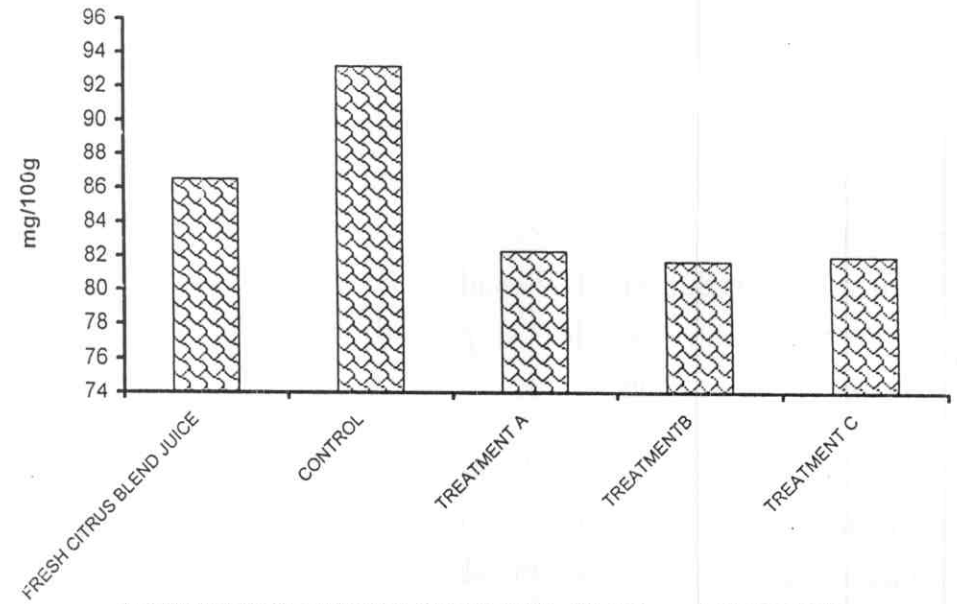


FIGURE (20):SERUM COLOR (TRANS. AT 420 nm) OF FRESH CITRUS BLEND JUICES AND DRINK TREAMENTS FOR SPORTS .

Browning index is measured by the optical density at 420 nm, results in Table (3) and Figure (21) showed that optical density of fresh citrus blend juice, citrus drink control, citrus drink treatment A, citrus drink treatment B and citrus drink treatment C were 0.043, 0.022, 0.038, 0.040 and 0.040, respectively. It could be noticed that high optical density was 0.043 for citrus blend juice whereas citrus drink control reduced to 0.022 because the juice was diluted with water to prepare drink. The results of citrus blend sport drinks treatments were lower than fresh citrus blend juice and higher than citrus drink control, this due to the high serium color in both sweet condensed milk and honey.

Viscosity is considered to be one of the important factors that influence quality of juices and drinks. The pectic substances in the drinks as well as number and shape of the suspended particles, practically affect the viscosity. Relative viscosity was carried out by measuring time (second) for drink against distilled time. Results in Table (3) and Figure (22) indicate that the relative viscosity for fresh citrus blend juice, citrus blend drink control, citrus blend drink treatment A, citrus blend drink treatment B and citrus blend drink treatment C were 1.585, 1.602, 1.617, 1.625 and 1.615. It could be concluded that relative viscosity of citrus blend juice was lower than treatments also treatments processed for diluted citrus blend juice (1:1 v/v), this due to that treatments contained sugars, honey and sweet condensed milk.

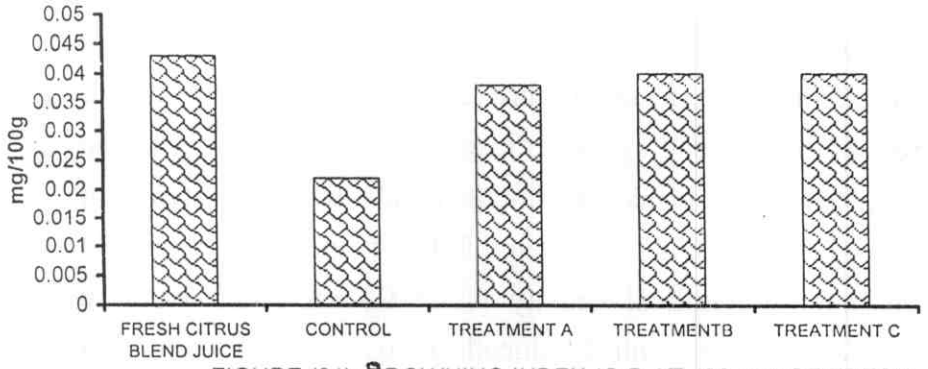


FIGURE (21): BROWNING INDEX (O.D AT 420 nm) OF FRESH CUTRUS BLEND JUICES AND DRINK TREATMENTS FOR SPORTS.

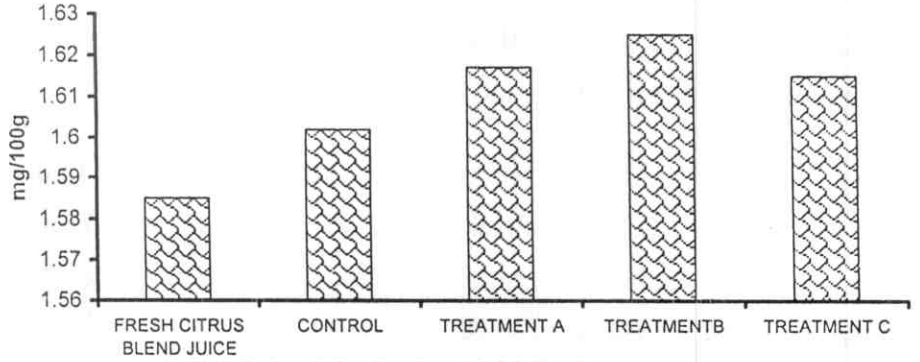


FIGURE (22):RELATIVE VISCOSITY OF FRESH CUTRUS BLEND JUICES AND DRINK TREATMENTS FOR SPORTS. .

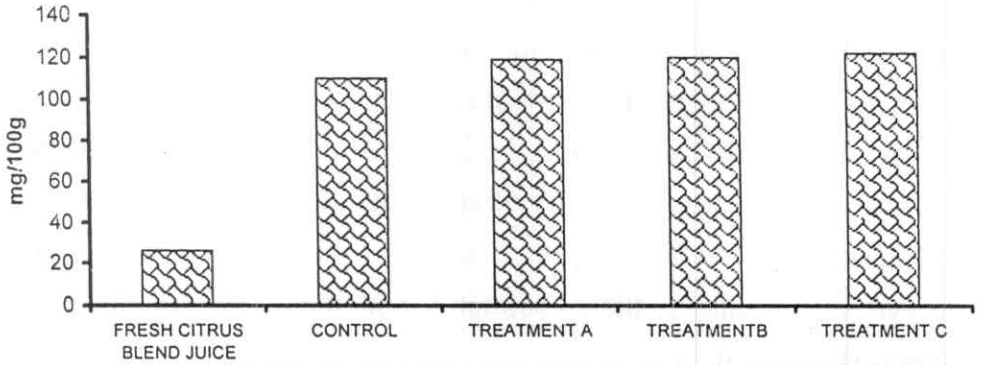


FIGURE (23): KILO CALORIC VALUE OF FRESH CUTRUS BLEND JUICES AND DRINK TREATMENTS FOR SPORTS.

Caloric values in juices mainly depend only on sugars. Citrus drink treatment contain sugar from citrus blend juice besides sugars were added from sucrose, glucose, fructose, sweet condensed milk and honey as well as a minor amount of amino acids. results in Table (4) and Figure (23) showed that fresh citrus blend juice had lower calorie which was 26 K. calorie, whereas citrus drink treatments had higher calorie which it was 110 K. calorie, 119 K. calorie, 120 K. calorie and 122 K. calorie for citrus drink control, citrus drink treatment A, citrus drink treatment B and citrus drink treatment C, respectively. This due to these treatments were processed with adding sugars, sweet condensed milk and honey.

Mineral salts in citrus juice is very important factor for sports, whereas the sports before, during and after exercises or matches lost about 1 liter/hour from contain about 3g salts presented in Table (4) and Figures (24 & 25) showed that Na, K, P, Mg, Zn, Cu, Ca and F were 1.82, 151.7, 11.9, 12.32, 0.07, 0.05, 11.22 and 0.19 mg/100g in fresh citrus fresh juice, respectively it reduced to 1.09, 89.32, 5.22, 6.91, 0.03, 0.02, 6.03 and 0.11 mg/100g in citrus drink control, respectively, whereas citrus drink treatment A, citrus drink treatment B and citrus drink treatment C contain 79.3, 79.8 and 80.1 mg/100g, 146.2, 162.5 and 162.9 mg/100g, 32.2, 33.7 and 33.8 mg/100g, 58.4, 59.7 and 60.2 mg/100g, 0.08, 0.08 and 0.09 mg/100g, 0.06, 0.07 and 0.06 mg/100g, 58.23, 58.61 and 58.50 mg/100g and 0.35, 0.39 and 0.37 mg/100g, respectively. This increase in citrus drink treatments due to adding mineral salts to treatment during process whereas citrus drink control without adding mineral salts.

Table (4) : Minerals in fresh citrus blend juices and citrus blend drink for sports

	Fresh citrus blend juice	Citrus blend sport drink treatments			
		Control	A	B	C
Sodium	1.82	1.09	79.3	79.8	80.1
Potassium	151.7	89.32	146.2	162.5	162.9
Phosphorus	11.9	5.22	32.2	33.7	33.8
Magnesium	12.32	6.91	58.4	59.7	60.2
Zinc	0.07	0.03	0.08	0.08	0.09
Copper	0.05	0.02	0.06	0.07	0.06
Calcium	11.22	6.03	58.23	58.61	58.50
iron	0.19	0.11	0.35	0.39	0.37

Control : Citrus blend drink with 20% sucrose

A : Citrus blend drink with 10% sucrose, 5% sweet condensed milk and 10% honey

B : Citrus blend drink with 5% glucose, 5% fructose, 5% sweet condensed milk and 10% honey.

C : Citrus blend drink with 2.5% sucrose, 5% glucose, 2.5% fructose, 5% sweet condensed milk and 10% honey

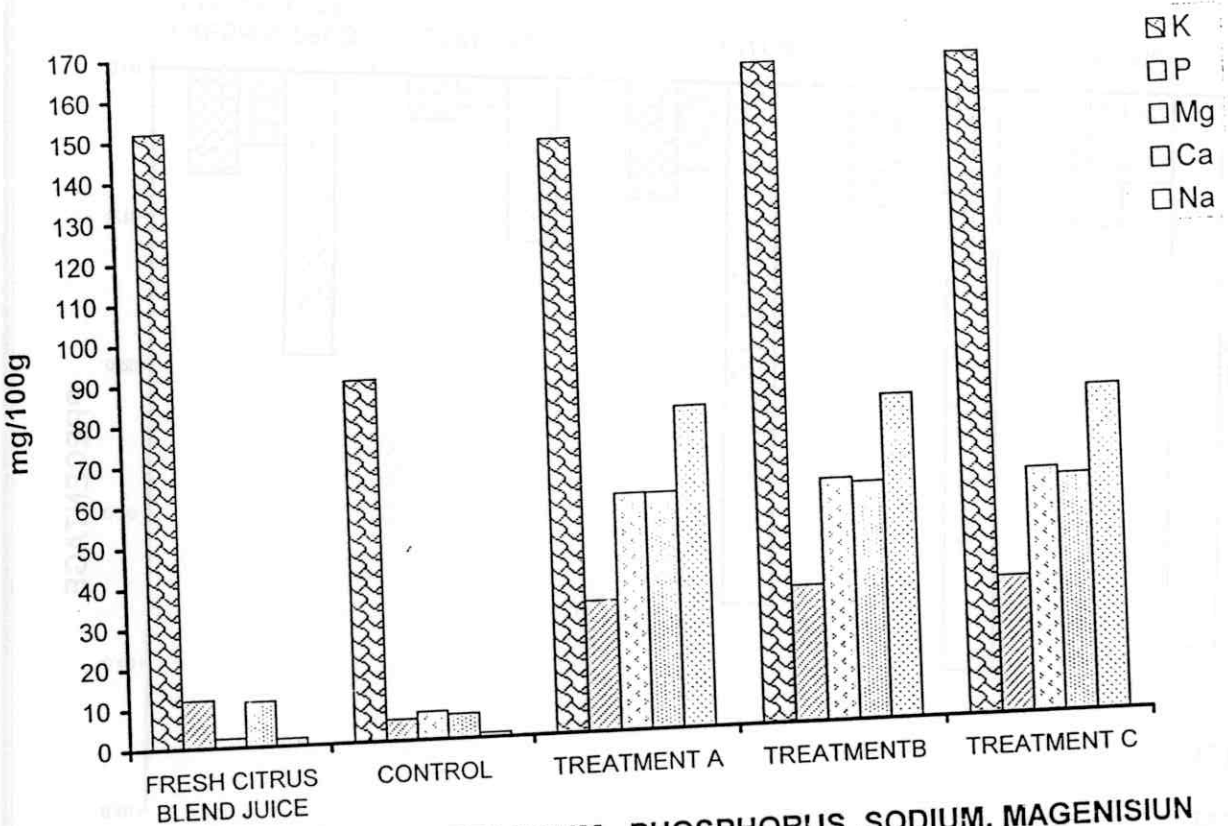
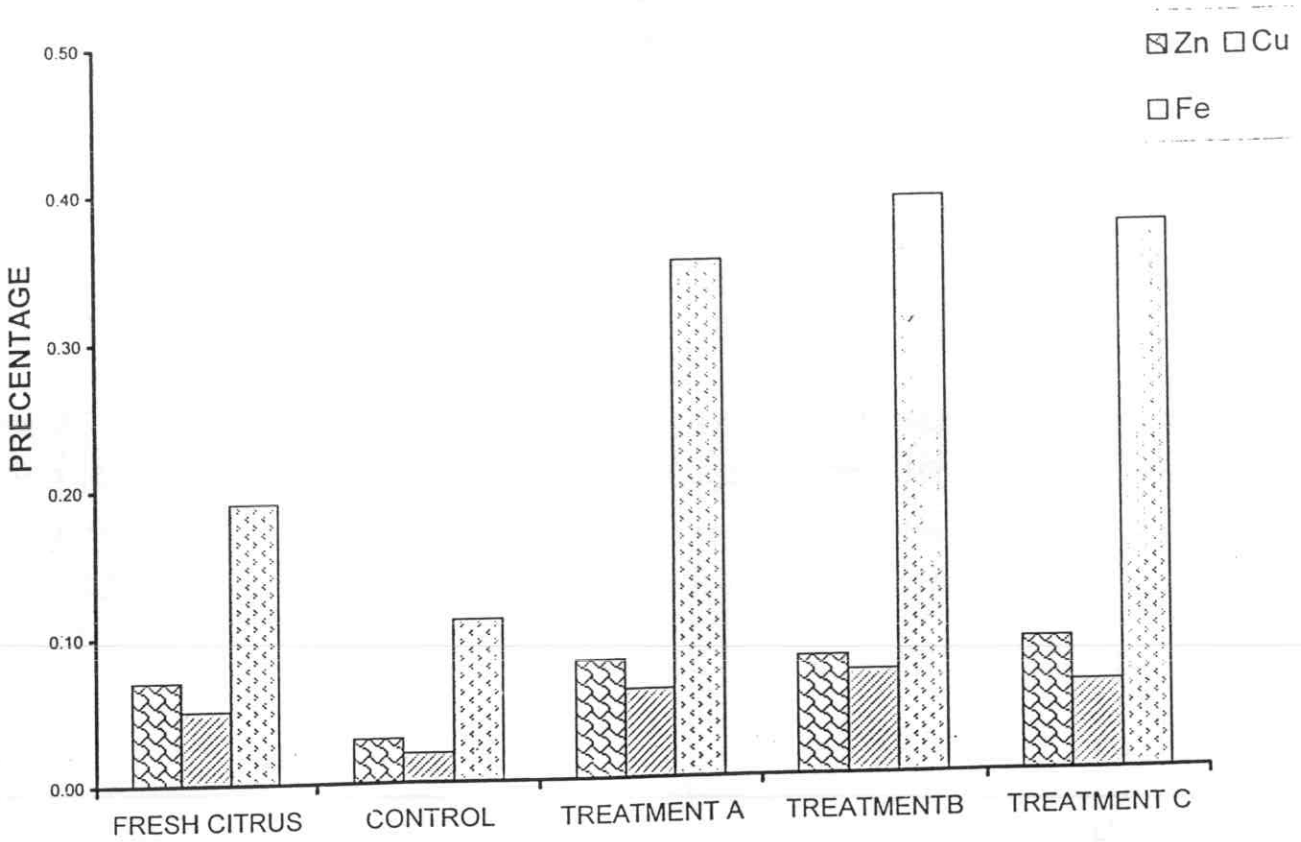


FIGURE (24) : POTASSIUM , PHOSPHORUS ,SODIUM, MAGENISIUN AND CALCIUM (mg/100g) OF FRESH CITRUS BLEND JUICES AND CITRUS BLEND DRINK TREATMENTS FOR SPORTS .



FIGURE(25): ZINK, COPPER AND IRON (mg/00g) OF FRESH CITRUS BLEND JUICES AND DRINK TREATMENTS FOR SPORTS.

4.3 Chemical composition of sport drinks during storage :

It is well known that the storage of pasteurized juice at suitable temperature increase its shelf life. This section of research was designated to study the changes which occur in the chemical constituents, physical properties and microbiological examination of the different sport drinks during storage for 3 months at ambient temperature (20-30°C) and 6 months at refrigerator (6±2°C) treatments prepared from citrus blend juice. It is well known that the storage of pasteurized juice at suitable temperature increase its shelf life.

4.3.1 Moisture content :

Concerning the effect of the storage for sport drinks treatments, from data in Table (5) and Figure (26a & b) it was observed that there was no different in moisture content between different treatments in both storage at 20-30°C or at 6±2°C in zero time. But there was a fluctuated results during storage in ambient temperature or in refrigerator. The moisture percentage of control treatment decrease from 78.85% to 73.8% to 73.80% at refrigerator in the end of storage, whereas sport drink treatment A, B and C during storage in both ambient temperature or refrigerator showed increase in moisture sometimes and /or decrease another time, but finally these changes in decrease or increase not more than 0.25% and 0.20% in the end of storage period at room temperature and refrigerator for all treatments, respectively.

Table (5) : Effect of storage periods and storage temperature on the moisture content percentage for sport drink treatments

Storage periods (month) / Treatments	Storage at ambient temperature (20-30°C)				Storage at 6±2°C			
	0	1	2	3	0	2	4	6
Control	73.85	73.73	73.75	73.78	73.85	73.77	73.79	73.80
A	73.80	73.85	73.81	73.83	73.87	73.80	73.83	73.82
B	73.84	73.81	73.78	73.85	73.80	73.85	73.81	73.79
C	73.83	73.72	73.80	73.80	73.89	73.80	73.79	73.81

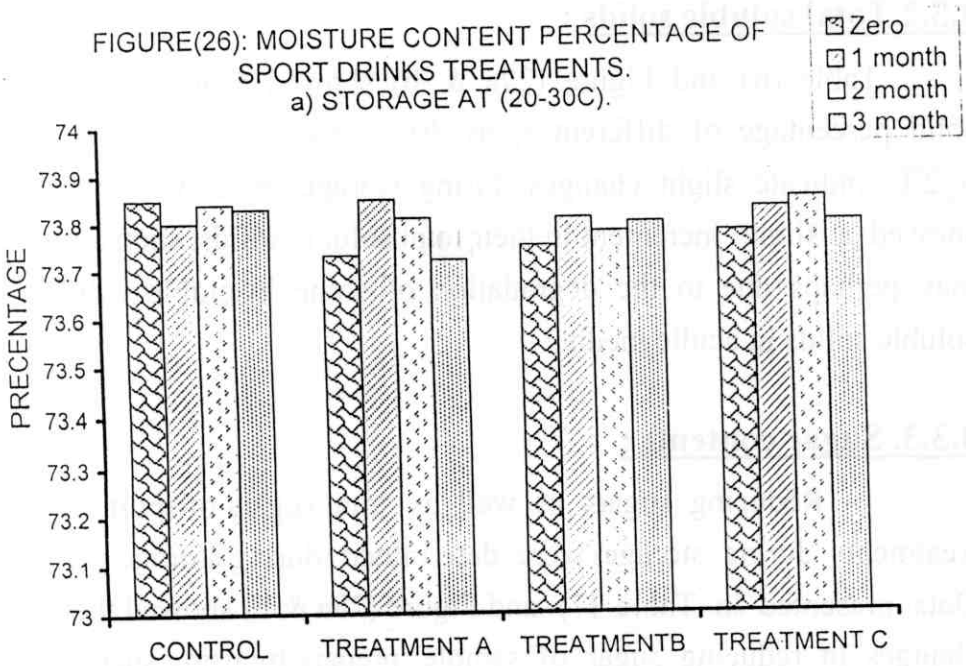
Control : Citrus blend drink with 20% sucrose

A : Citrus blend drink with 10% sucrose, 5% sweet condensed milk and 10% honey

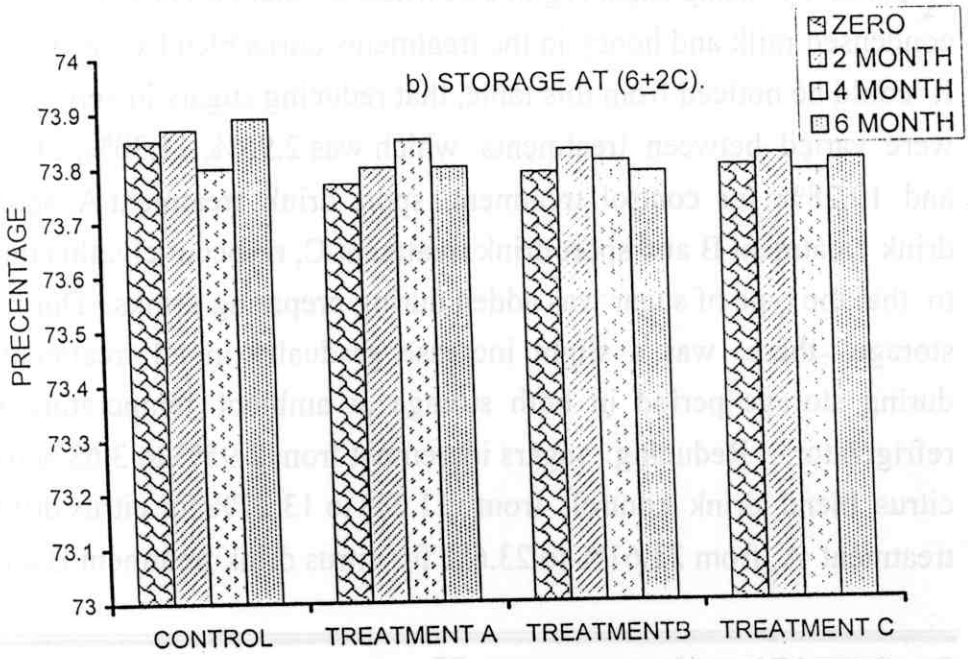
B : Citrus blend drink with 5% glucose, 5% fructose, 5% sweet condensed milk and 10% honey.

C : Citrus blend drink with 2.5% sucrose, 5% glucose, 2.5% fructose, 5% sweet condensed milk and 10% honey

FIGURE(26): MOISTURE CONTENT PERCENTAGE OF SPORT DRINKS TREATMENTS.
a) STORAGE AT (20-30C).



b) STORAGE AT (6±2C).



4.3.2 Total soluble solids :

Table (6) and Figure (27a & b) showed that total soluble solid percentage of different sport drinks stored at 20-30°C and 6±2°C indicate slight changes during storage, wherever samples showed a slight increment in their total soluble solids, such a trend may perhaps due to the degradation of some insoluble solids to soluble solids in acidic media.

4.3.3. Sugar contents :

Reducing sugars as well as total sugars of sport drinks treatments during storage were determined during storage period. Data presented in Table (7) and Figure (28a & b) showed that the changes in reducing sugar of sample prepare by using sucrose (~ 20%) in the control citrus blend drink as well as samples were prepared by using sugars (glucose, fructose, sucrose) besides sweet condensed milk and honey in the treatments citrus blend sport drink. It could be noticed from this table, that reducing sugars in zero time were varied between treatments which was 2.95%, 11.30%, 21.61 and 19.28% for control treatment, sport drink treatment A, sport drink treatment B and sport drink treatment C, respectively, this due to that the type of sugar was added during preparing drinks. During storage, there was a slight increase gradually in all treatments during storage period in both storage at ambient temperature or refrigerator. Reducing sugars increment from 2.95% to 3.63% for citrus blend drink control, from 11.3% to 13.27% for citrus drink treatment A, from 21.61% to 23.6% for citrus drink treatment B and

from 19.28% to 21.78% for citrus drink treatment C during storage at ambient temperature, but during storage in refrigerator the reducing sugar increase from 2.95% to 3.32% for citrus drink control, from 11.28% to 13.11% for citrus drink treatment A, from 21.57% to 23.46% for citrus drink treatment B, and from 19.30% to 21.66% for citrus drink treatment C. This increment trend may perhaps due to the change of some non-reducing sugars to reducing sugar in acidic media and the storage period.

Total sugars in all treatments were determined as total reducing sugars it including sugars in citrus blend juices and materials which added to prepare sport drink such as sucrose, glucose, fructose, sweet condensed milk and honey. Data in Table (8) and Figure (29a & b) appear that total sugars seems to be no change, but there was a slight decrease during storage was observed, this may be perhaps due to non enzymatic reaction between small amount of sugars with organic acid especially amino acids. During storage the total sugars in citrus drink treatments were decreased from 24.1% to 23.88% for control, from 24.70% to 24.17% for treatment A, from 24.8% to 24.92% for treatment B and from 24.65% to 24.58% to 24.41% for treatment C during storage at ambient temperature, but during storage at refrigerator total sugar for all citrus drink treatments were decreased from 24.10% to 23.90% for control, from 24.72% to 24.55% for treatment A, from 24.80% to 24.63% for treatment B and from 24.66% to 24.44% for treatment C.

Table (6) : Effect of storage periods and storage temperature on the total soluble solids percentage for sport drink treatments

Storage periods (month) / Treatments	Storage at ambient temperature (20-30°C)				Storage at 6±2°C			
	0	1	2	3	0	2	4	6
Control	25.5	25.8	26.0	26.1	25.5	25.6	25.7	25.9
A	26.3	26.5	26.6	26.9	26.3	26.5	26.6	26.7
B	26.6	26.6	26.7	26.8	26.6	26.7	26.9	27.0
C	26.4	26.6	26.8	26.8	26.4	26.5	26.6	26.8

Control : Citrus blend drink with 20% sucrose

A : Citrus blend drink with 10% sucrose, 5% sweet condensed milk and 10% honey

B : Citrus blend drink with 5% glucose, 5% fructose, 5% sweet condensed milk and 10% honey.

C : Citrus blend drink with 2.5% sucrose, 5% glucose, 2.5% fructose, 5% sweet condensed milk and 10% honey

Figure (27) Total soluble solids percentage of sport drinks treatments.

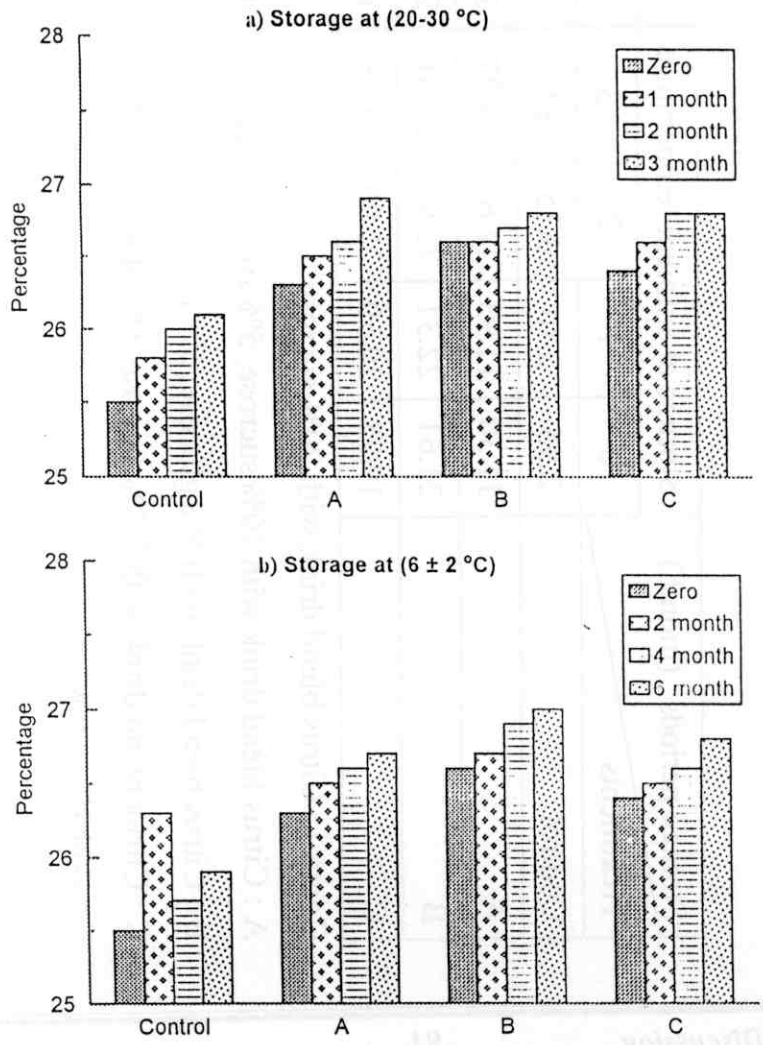


Table (7) : Effect of storage periods and storage temperature on the reducing sugars percentage for sport drink treatments

Storage periods (month) / Treatments	Storage at ambient temperature				Storage at 6±2°C			
	0	1	2	3	0	2	4	6
Control	2.95	3.10	3.35	3.63	2.95	3.05	3.15	3.32
A	11.30	11.93	12.65	13.27	11.28	11.82	12.56	13.11
B	21.61	22.31	22.97	23.61	21.57	22.25	22.89	23.46
C	19.28	20.59	21.00	21.78	19.30	20.32	20.93	21.66

Control : Citrus blend drink with 20% sucrose

A : Citrus blend drink with 10% sucrose, 5% sweet condensed milk and 10% honey

B : Citrus blend drink with 5% glucose, 5% fructose, 5% sweet condensed milk and 10% honey.

C : Citrus blend drink with 2.5% sucrose, 5% glucose, 2.5% fructose, 5% sweet condensed milk and 10% honey

Figure (28) Reducing sugar percentage of sport drinks treatments.

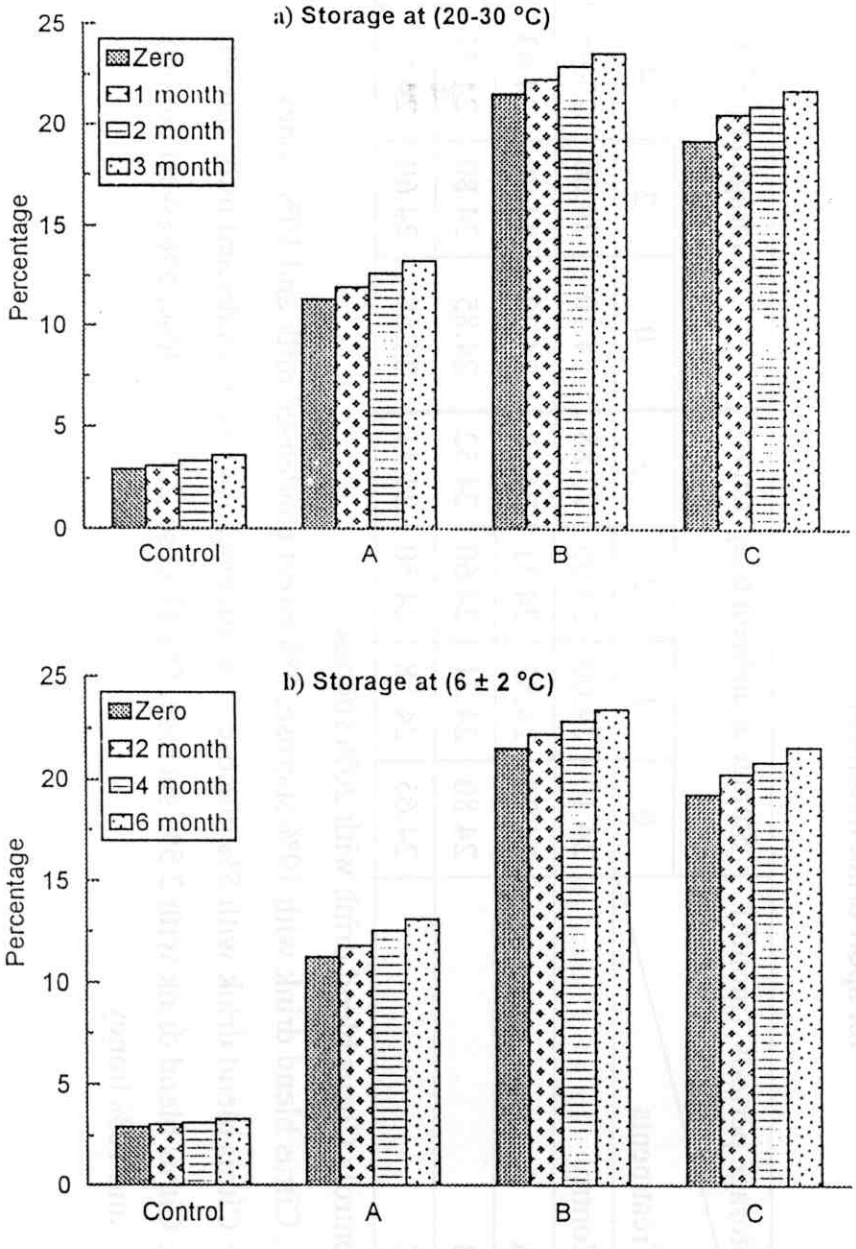


Table (8) : Effect of storage periods and storage temperature on the total sugars percentage for sport drink treatments

Storage periods (month) / Treatments	Storage at ambient temperature				Storage at 6±2°C			
	0	1	2	3	0	2	4	6
Control	24.10	24.00	23.95	23.88	24.10	24.00	23.95	23.90
A	24.70	24.52	24.31	24.17	24.72	24.70	24.63	24.55
B	24.80	24.71	24.60	24.52	24.85	24.80	24.72	24.63
C	24.65	24.58	24.50	24.41	24.66	24.60	24.51	24.44

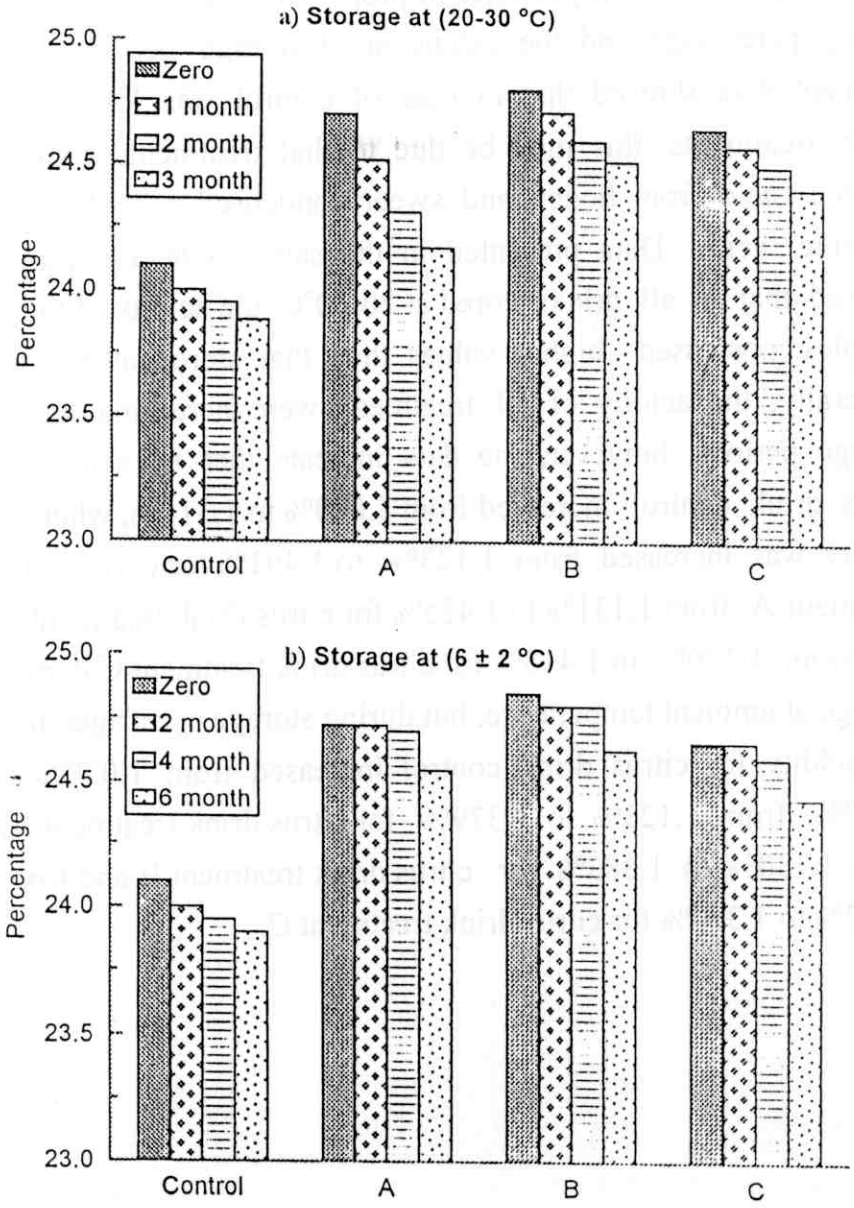
Control : Citrus blend drink with 20% sucrose

A : Citrus blend drink with 10% sucrose, 5% sweet condensed milk and 10% honey

B : Citrus blend drink with 5% glucose, 5% fructose, 5% sweet condensed milk and 10% honey.

C : Citrus blend drink with 2.5% sucrose, 5% glucose, 2.5% fructose, 5% sweet condensed milk and 10% honey

Figure (29) Total sugar percentage of sport drinks treatments.



4.3.4 Total acidity :

With respect to the changes in acidity (as citric acid) during storage under the tested conditions, Table (9) and Figure (30a & b) showed the presence of proportional relation between acidity percentage and the extension of storage periods. The obtained data showed that in case of control was lower than other treatments, this may be due to that treatments contain organic acid from honey and sweet condensed milk besides ascorbic acid. Data presented in the same table and figure showed that in all drinks stored at 20-30°C, the acidity of these samples possessed higher values than that stored at 6±2°C. Generally, the acidity of all treatments were increasing during storage periods, however, the data indicate that the acidity of citrus drink control increased from 1.070% to 1.311%, whereas acidity was increased from 1.123% to 1.401% for citrus drink treatment A, from 1.131% to 1.425% for citrus drink treatment B and from 1.130% to 1.418% for citrus drink treatment C during storage at ambient temperature, but during storage at refrigerator, the acidity for citrus drink control increased from 1.070% to 1.227%, from 1.123% to 1.379% for citrus drink treatment A, from 1.130% to 1.383% for citrus drink treatment B and from 1.132% to 1.380% for citrus drink treatment C.

Table (9) : Effect of storage periods and storage temperature on the total acidity percentage for sport drink treatments

Storage periods (month) / Treatments	Storage at ambient temperature				Storage at 6±2°C			
	0	1	2	3	0	2	4	6
Control	1.070	1.092	1.103	1.311	1.070	1.085	1.052	1.227
A	1.123	1.189	1.215	1.401	1.123	1.167	1.183	1.379
B	1.131	1.195	1.242	1.425	1.130	1.178	1.192	1.383
C	1.130	1.190	1.234	1.418	1.132	1.171	1.165	1.380

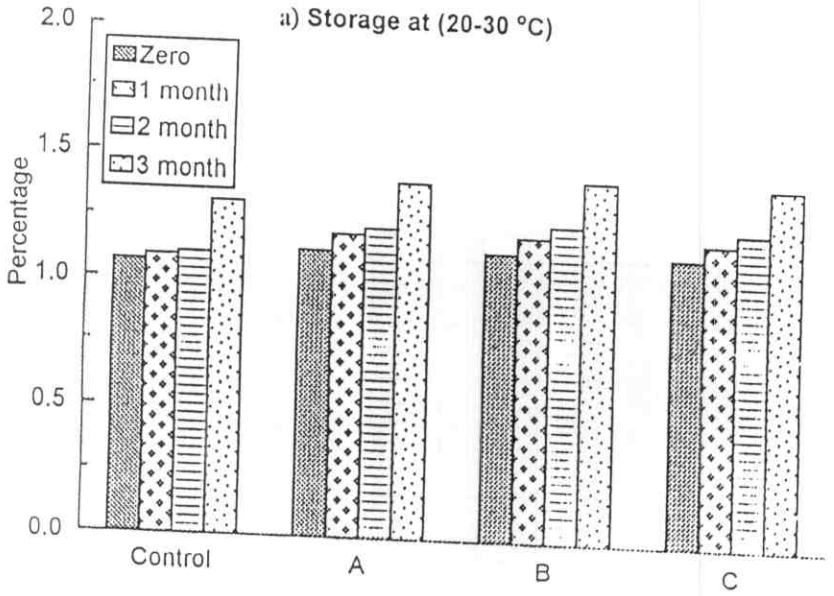
Control : Citrus blend drink with 20% sucrose

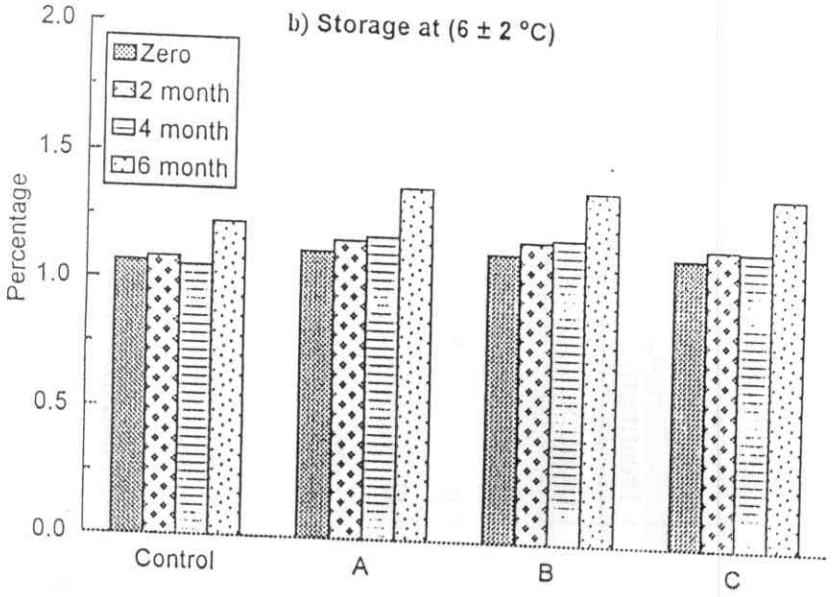
A : Citrus blend drink with 10% sucrose, 5% sweet condensed milk and 10% honey

B : Citrus blend drink with 5% glucose, 5% fructose, 5% sweet condensed milk and 10% honey.

C : Citrus blend drink with 2.5% sucrose, 5% glucose, 2.5% fructose, 5% sweet condensed milk and 10% honey

Figure (30) Total acidity percentage of sport drinks treatments.





4.3.5 Ascorbic acid :

Ascorbic acid is an important nutrient for sports. Temperature, the presence of oxygen, exposure to light and length of storage period are the most critical factors influencing the quality of fruit and vegetable juices results as well as enhancing the degradation of ascorbic acid ***(Kennedy et al., 1992*** and ***Shaw and Moshonos, 1991)***. Therefore, the relation between ascorbic acid content of the investigated samples (citrus drink control, citrus drink treatment A, citrus drink treatment B and citrus drink treatment C) and storage at different temperatures (20-30°C and 6±2°C) is shown in Table (10) and Figure (31a & b). Citrus drink control was lower content of ascorbic acid that citrus drink treatment, this may be due to the ascorbic acid content in honey and the amount which added during processing citrus drink for sports. During storage at ambient temperature, the ascorbic acid content in citrus drink control was decreased from 26.0 mg/100g to 20.0 mg/100g, from 68.0 mg/100g to 57.8 mg/100g for citrus drink treatment A, from 68.2 mg/100g to 58.0 mg/100g for citrus drink treatment B and from 68.10 mg/100g to 57.9 mg/100g for citrus drink treatment C, whereas during storage at refrigerator, the ascorbic acid decreased from 26.0, 68.10, 68.20 and 68.21 mg/100g to 20.8, 58.7, 59.3 and 58.8 mg/100g for citrus drink control, treatment A, treatment B and treatment C, respectively. In general, ascorbic acid decreased gradually with the prolongation of storage period. The reduction in ascorbic acid was higher increase of the drinks stored at 20-30°C than that stored at lower temperatures 6±2°C.

Table (10) : Effect of storage periods and storage temperature on the ascorbic acid (mg/100g) for sport drink treatments

Storage periods (month) / Treatments	Storage at ambient temperature				Storage at 6±2°C			
	0	1	2	3	0	2	4	6
Control	26.0	24.3	22.1	20.0	26.0	25.2	23.5	20.8
A	68.0	64.5	61.0	57.8	68.10	65.8	62.3	58.7
B	68.2	64.6	61.5	58.0	68.20	65.9	62.8	59.3
C	68.10	64.4	61.3	57.9	68.21	65.7	62.6	58.8

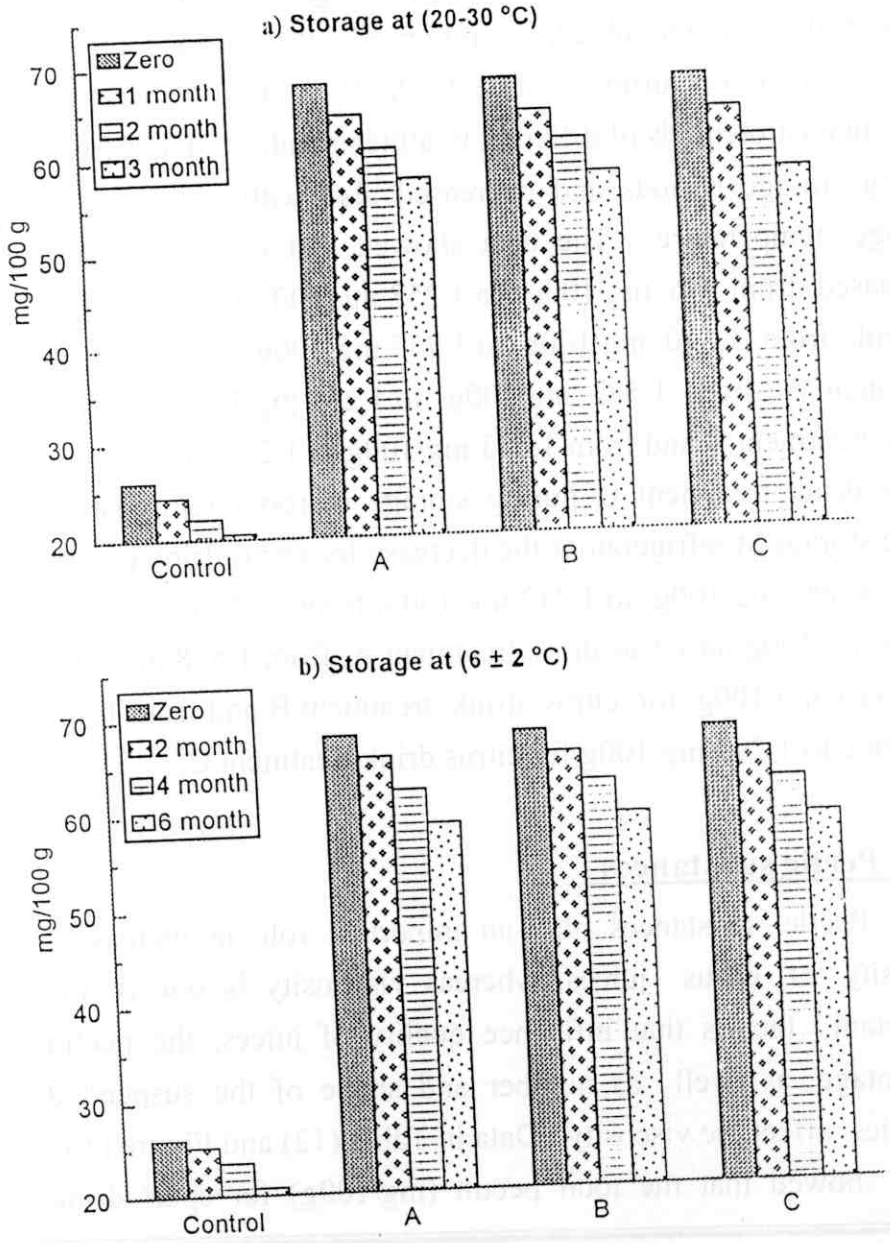
Control : Citrus blend drink with 20% sucrose

A : Citrus blend drink with 10% sucrose, 5% sweet condensed milk and 10% honey

B : Citrus blend drink with 5% glucose, 5% fructose, 5% sweet condensed milk and 10% honey.

C : Citrus blend drink with 2.5% sucrose, 5% glucose, 2.5% fructose, 5% sweet condensed milk and 10% honey

Figure (31) Ascorbic acid (mg/100g) of sport drinks treatments.



4.3.6 Total carotenoids :

Color change is one of the most visible effects of long-term storage. The major problem associated with citrus juice quality is color. Therefore, carotenoids concentration of the tested samples is given in Table (11) and Figure (32a & b). Data showed that carotenoid concentration of citrus drink control is higher than citrus drink treatments A, B and C. Data proved also, that carotenoids of different treatments indicated a decrease during storage periods and decreased also with increasing of storage temperature. The data showed that carotenoids was decreased from 1.6 mg/100g to 1.258 mg/100g for citrus drink control, from 1.570 mg/100g to 1.237 mg/100g for citrus drink treatment A, from 1.582 mg/100g to 1.219 mg/100g for citrus drink treatment B and from 1.553 mg/100g to 1.228 mg/100g for citrus drink treatment C during storage at room temperature, while storage at refrigeratoor the decrease for citrus drink control from 1.600 mg/100g to 1.312 mg/100g, from 1.575 mg/100g to 1.309 mg/100g for citrus drink treatment A, from 1.578 mg/100g to 1.310 mg/100g for citrus drink treatment B and from 1.561 mg/100g to 1.297 mg/100g for citrus drink treatment C.

4.3.7 Pectic substances :

Pectic substances play an important role in increasing viscosity of citrus juices, whereas viscoosity is one of the important factors that influence quality of juices, the pectin percentage as well as number and shape of the suspended particles affect the viscosity. Data in Table (12) and Figure (33a & b) showed that the total pectin (mg/100g) for sport drink

treatments during storage at room temperature and at refrigerator for 3 and 6 months, respectively. Data appear that there was a slight decrease in total pectin during storage periods and the decrease in total pectin during storage periods and the decrease was higher at room temperature that at refrigerator, this may be perhaps due to degradation of pectic substances to organic due to degradation of pectic substances to organic acids during storage. Data showed that citrus control was decreased from 22.95 mg/100g to 19.85 mg/100g, the citrus drink treatments were decreased during storage at room temperature from 23.09 mg/100g to 20.00 mg/100g for citrus drink treatment A, from 32.2 mg/100g to 20.05 mg/100g for citrus drink treatment B and from 23.05 mg/100g to 20.02 mg/100g for citrus drink treatment C, whereas during storage at refrigerator, the decrease of total pectin from 20.90 mg/100g to 21.31 mg/100g for citrus drink control, from 23.15 mg/100g to 20.55 mg/100g for citrus drink treatment A, from 23.20 mg/100g to 20.65 mg/100g for citrus drink treatment B and from 23.10 mg/100g to 20.60 mg/100g for citrus drink treatment C.

4.3.8 Formol number :

Formol number is an idea that is related to the free amino acid control of juice. It is well known that in the presence of reducing sugars the browning reaction can take place even at low temperature. Table (13) and Figure (34a & b) showed the formol number of different nectars produced by different treatments during storage for 3 months and 6 months at room temperature and at refrigerator, respectively.

Table (11) : Effect of storage periods and storage temperature on the carotenoids (mg/100g) for sport drink treatments

Storage periods (month) / Treatments	Storage at ambient temperature				Storage at 6±2°C			
	0	1	2	3	0	2	4	6
Control	1.600	1.493	1.381	1.258	1.600	1.528	1.452	1.312
A	1.570	1.482	1.375	1.237	1.575	1.516	1.447	1.309
B	1.582	1.485	1.379	1.219	1.578	1.520	1.449	1.310
C	1.553	1.448	1.337	1.228	1.561	1.500	1.432	1.297

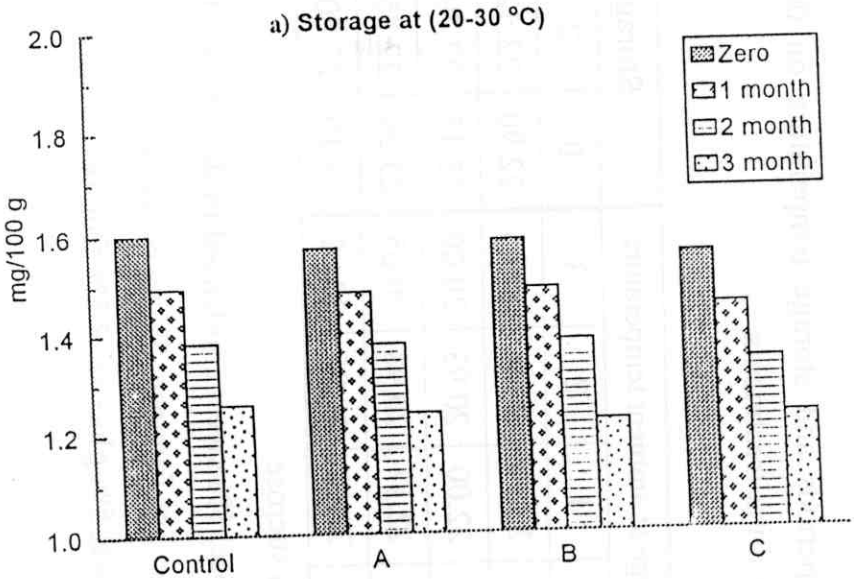
Control : Citrus blend drink with 20% sucrose

A : Citrus blend drink with 10% sucrose, 5% sweet condensed milk and 10% honey

B : Citrus blend drink with 5% glucose, 5% fructose, 5% sweet condensed milk and 10% honey.

C : Citrus blend drink with 2.5% sucrose, 5% glucose, 2.5% fructose, 5% sweet condensed milk and 10% honey

Figure (32) Total carotenoids (mg/100g) of sport drinks treatments.



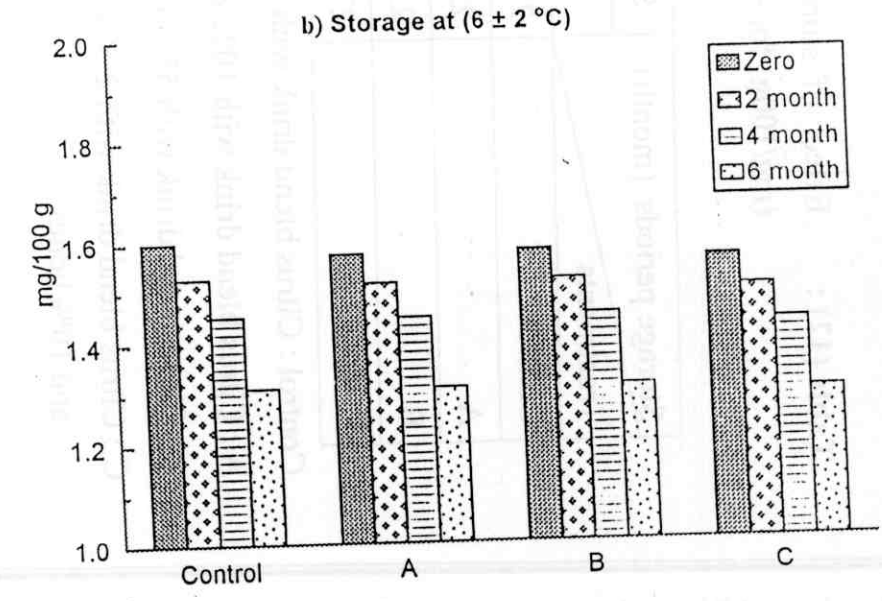


Table (12) : Effect of storage periods and storage temperature on the total pectin (mg/100g) for sport drink treatments

Storage periods (month) / Treatments	Storage at ambient temperature				Storage at 6±2°C			
	0	1	2	3	0	2	4	6
Control	22.95	22.19	21.0	19.85	22.90	22.52	22.05	21.31
A	23.09	22.00	20.93	20.00	23.15	22.79	21.68	20.55
B	23.20	22.17	20.98	20.05	23.20	22.85	21.79	20.65
C	23.05	22.11	20.95	20.02	23.10	22.80	21.74	20.60

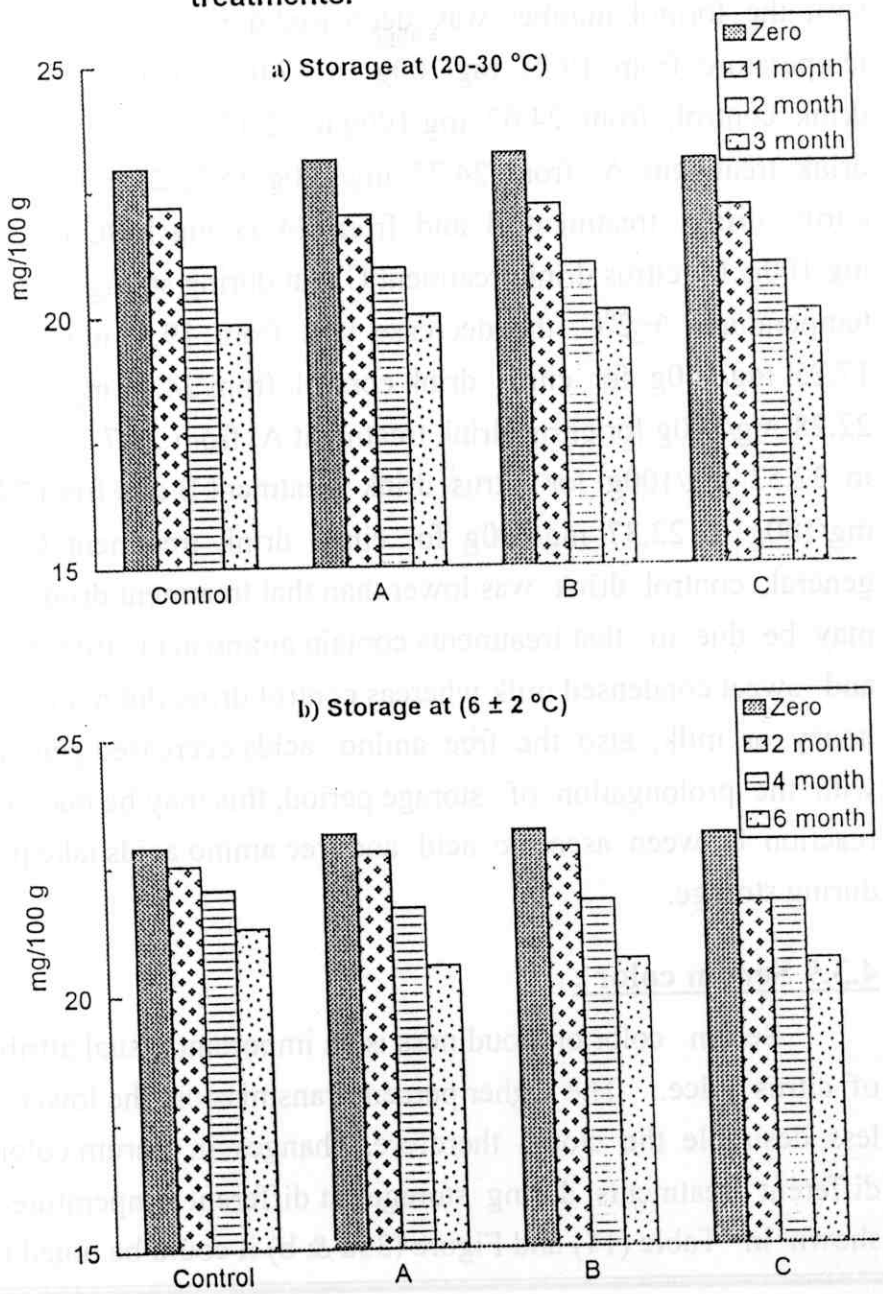
Control : Citrus blend drink with 20% sucrose

A : Citrus blend drink with 10% sucrose, 5% sweet condensed milk and 10% honey

B : Citrus blend drink with 5% glucose, 5% fructose, 5% sweet condensed milk and 10% honey.

C : Citrus blend drink with 2.5% sucrose, 5% glucose, 2.5% fructose, 5% sweet condensed milk and 10% honey

Figure (33) Total pectin (mg/100g) of sport drinks treatments.



During storage, the free amino acid were decreased gradually, meanwhile, there were some decreases in its values during storage periods, such slight change might indicate the non-enzymatic browning with reducing sugars. In each drinks sort, the formol number was decreased during storage at room temperature from 19.25 mg/100g to 17.00 mg/100g for citrus drink control, from 24.62 mg/100g to 22.12 mg/100g for citrus drink treatment A, from 24.75 mg/100g to 22.25 mg/100g for citrus drink treatment B and from 24.63 mg/100g to 22.15 mg/100g for citrus drink treatment C, but during storage at lower temperatures 6±2°C, the decrease was from 19.2 mg/100g to 17.25 mg/100g for citrus drink control, from 24.65 mg/100g to 22.28 mg/100g for citrus drink treatment A, from 24.77 mg/100g to 22.52 mg/100g for citrus drink treatment B and from 24.65 mg/100g to 22.37 mg/100g for citrus drink treatment C. In general, control drink was lower than that treatment drinks, this may be due to that treatments contain amino acids from honey and sweet condensed milk whereas control drink did not contain honey or milk, also the free amino acids decreased generally with the prolongation of storage period, this may be due to the reaction between ascorbic acid and free amino acids take place during storage.

4.3.9 Serum color :

Serum color or cloudiness is an important visual attribute of citrus juice. The higher percent transmission, the lower and less desirable the cloud, therefore, changes in serum color of different treatments during storage at different temperature are shown in Table (14) and Figure (35a & b) it could be noted that

there was a continuous decrease in serum color of the concentrates with the progress in the storage period. The reduction in serum color was slight higher in case of the storage at room temperature than that stored at refrigerator. The available data given in the same table showed that serum color was changed to higher values by extending storage period. With respect to the above data, the results showed that the serum color of citrus drink control during storage at room temperature was decreased from 89.1% to 82.2%, from 82.7% to 75.8% for citrus drink treatment A, from 82.3% to 76.0% for citrus drink treatment B and from 82.5% to 75.3% for citrus drink treatment C. Whereas, during storage in refrigerator the decrease of serum color (transmission) from 89.1% to 82.8% for citrus drink control, from 82.6% to 76.1% for citrus drink treatment A, from 82.5% to 75.8% for citrus drink treatment B and from 82.7% to 75.9% for citrus drink treatment C.

4.3.10 Browning index :

Although the mechanism responsible for the deterioration on flavor with aging is not well understood, especially in pasteurized single-stregnth juice, but non-enzymatic browning reactions are generally believed to be involved. This is mainly based on the well-known correlation of browning increment with the prolongation of storage time and temperature ***(Trammell et al., 1986)***. Therefore, changes in browning index (as O.D. at 420 nm) of the tested citrus drink control and citrus drink treatments A, B, and C during storage period at room temperature and refrigerator are given in Tables (15 & 16) and Figure (36a & b).

Table (13) : Effect of storage periods and storage temperature on the total free amino acids (mg/100g) for sport drink treatments

Storage periods (month) / Treatments	Storage at ambient temperature				Storage at 6±2°C			
	0	1	2	3	0	2	4	6
Control	19.25	18.82	18.13	17.00	19.20	18.92	18.27	17.25
A	24.62	23.85	23.05	22.12	24.65	23.89	23.22	22.28
B	24.75	23.90	23.18	22.25	24.77	24.00	23.35	22.52
C	24.63	23.89	23.12	22.15	24.65	24.00	23.31	22.37

Control : Citrus blend drink with 20% sucrose

A : Citrus blend drink with 10% sucrose, 5% sweet condensed milk and 10% honey

B : Citrus blend drink with 5% glucose, 5% fructose, 5% sweet condensed milk and 10% honey.

C : Citrus blend drink with 2.5% sucrose, 5% glucose, 2.5% fructose, 5% sweet condensed milk and 10% honey

Figure (34) Total free amino acid (mg/100g) of sport drinks treatments.

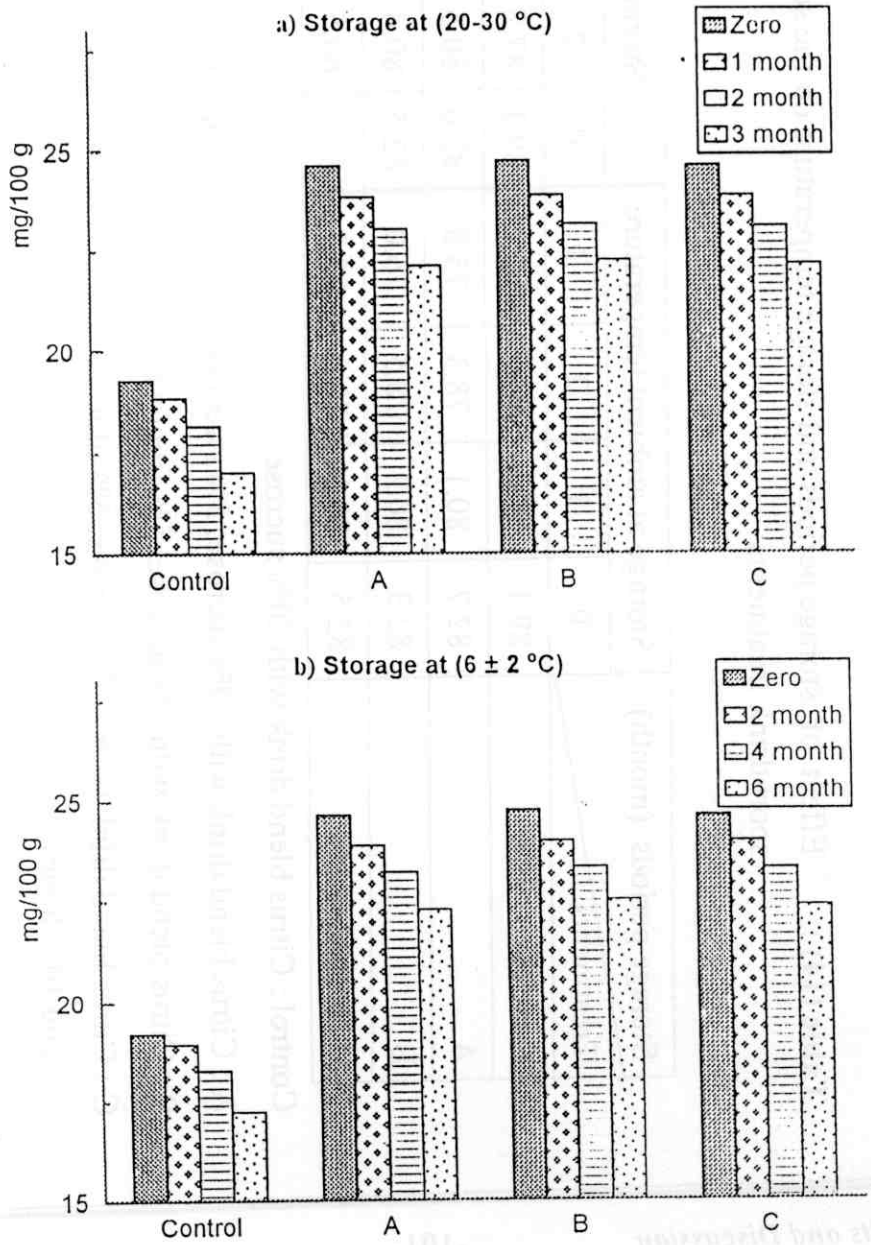


Table (14) : Effect of storage periods and storage temperature on the serium color for sport drink treatments

Storage periods (month) / Treatments	Storage at ambient temperature				Storage at 6±2°C			
	0	1	2	3	0	2	4	6
Control	89.1	87.3	84.5	82.2	89.1	87.8	84.9	82.8
A	82.7	80.1	78.3	75.8	82.6	80.5	78.6	76.1
B	82.3	80.2	78.5	76.0	82.5	80.4	78.9	75.8
C	82.5	80.1	78.5	75.3	82.7	80.5	79.1	75.9

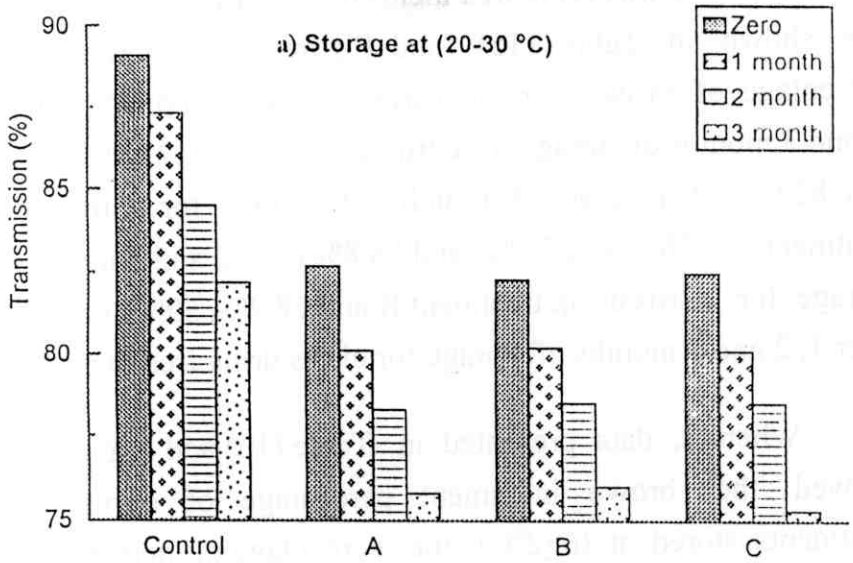
Control : Citrus blend drink with 20% sucrose

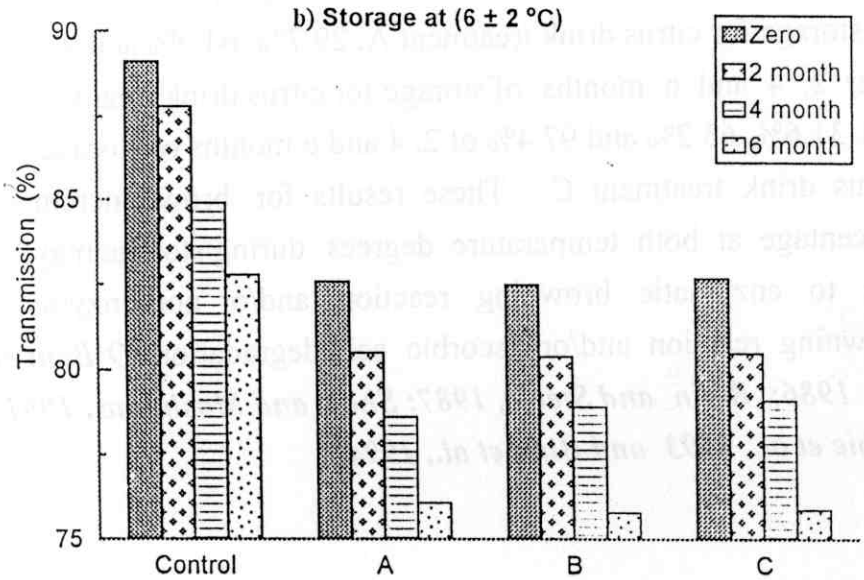
A : Citrus blend drink with 10% sucrose, 5% sweet condensed milk and 10% honey

B : Citrus blend drink with 5% glucose, 5% fructose, 5% sweet condensed milk and 10% honey.

C : Citrus blend drink with 2.5% sucrose, 5% glucose, 2.5% fructose, 5% sweet condensed milk and 10% honey

Figure (44) Serium color (Trans. at 420 nm) of sport drinks treatments.





Browning index of the citrus drink control was lower than citrus drink treatments, this may be perhaps due to the browning compounds content in sweet condensed milk and honey, however, the browning index. The percentage of brown increment of citrus drink treatments during storage at (20-30°C) was shown in Table (15) and Figure (36a), however, the percentage of brown increment was 15%, 40% and 65% after 1, 2 and 3 months of storage for citrus drink control, 22.9%, 48.6% and 82.9% of 1, 2 and 3 months of storage for citrus drink treatment A, 26.3%, 57.9% and 86.8% of 1, 2 and 3 months of storage for citrus drink treatment B and 28.2%, 59% and 94.9% after 1, 2 and 3 months of storage for citrus drink treatment C.

Whereas, data presented in Table (16) and Figure (36b) showed the brown increment percentage of citrus drink treatments stored at (6±2°C), the percentage of increment was 20%, 40% and 70% after 2, 4 and 6 months of storage for citrus drink control, 25.7%, 54.3% and 85.7% after 2, 4 and 6 months of storage for citrus drink treatment A, 29.7%, 64.9% and 97.3% after 2, 4 and 6 months of storage for citrus drink treatment B and 31.6%, 63.2% and 97.4% of 2, 4 and 6 months of storage for citrus drink treatment C. These results for brown increment percentage at both temperature degrees during storage may be due to enzymatic browning reaction and/or non-enzymatic browning reaction and/or ascorbic acid degradation ***(O'Bein et al., 1986; Bolin and Steele, 1987; Shaw and Moshonas, 1991; Babie et al., 1993 and Bian et al., 1994).***

Table (15) : Effect of storage periods on the browning index and % of increasing for sport drink treatments at (20-30°C)

Storage periods (month) / Treatments	0		1		2		3	
	O.D at 420nm	% of brown increment	O.D at 420nm	% of brown increment	O.D at 420nm	% of brown increment	O.D at 420nm	% of brown increment
Control	0.02	0	0.023	15.0	0.028	40.0	0.033	65.3
A	0.035	0	0.043	22.9	0.052	48.6	0.064	82.9
B	0.038	0	0.048	26.3	0.060	57.9	0.071	86.8
C	0.039	0	0.050	28.2	0.062	59.0	0.076	94.9

Control : Citrus blend drink with 20% sucrose

A : Citrus blend drink with 10% sucrose, 5% sweet condensed milk and 10% honey

B : Citrus blend drink with 5% glucose, 5% fructose, 5% sweet condensed milk and 10% honey.

C : Citrus blend drink with 2.5% sucrose, 5% glucose, 2.5% fructose, 5% sweet condensed milk and 10% honey

Table (16) : Effect of storage periods on the browning index and % of increasing for sport drink treatments at (6±2°C)

Storage periods (month) / Treatments	0		2		4		6	
	O.D at 420nm	% of brown increment	O.D at 420nm	% of brown increment	O.D at 420nm	% of brown increment	O.D at 420nm	% of brown increment
Control	0.02	0	0.024	20.0	0.028	40.0	0.034	70.0
A	0.035	0	0.044	25.7	0.054	54.3	0.065	85.7
B	0.038	0	0.048	29.7	0.061	64.9	0.073	97.3
C	0.039	0	0.050	31.6	0.062	63.2	0.075	97.4

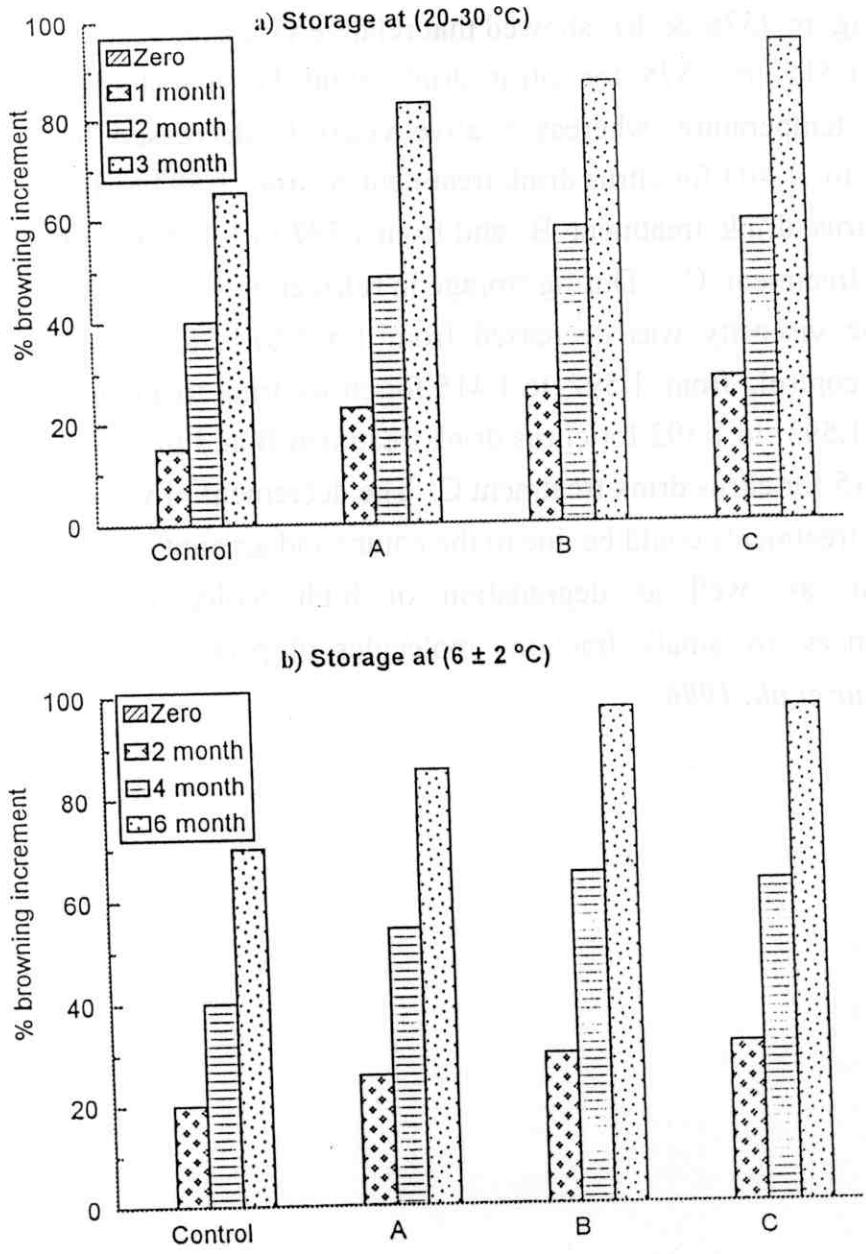
Control : Citrus blend drink with 20% sucrose

A : Citrus blend drink with 10% sucrose, 5% sweet condensed milk and 10% honey

B : Citrus blend drink with 5% glucose, 5% fructose, 5% sweet condensed milk and 10% honey.

C : Citrus blend drink with 2.5% sucrose, 5% glucose, 2.5% fructose, 5% sweet condensed milk and 10% honey.

Figure (36) Browning index increasement percentae of sport drinks treatments.



4.3.11 Relative viscosity :

The increment of relative viscosity that noticed in citrus drink treatments than citrus drink control may be due to the addition of sugars, sweet condensed milk and honey. Table (17) and Figure (37a & b) showed that relative viscosity decreased from 1.515 to 1.375 for citrus drink control during storage at room temperature, whereas relative viscosity decreased from 1.595 to 1.403 for citrus drink treatment A, from 1.593 to 1.392 for citrus drink treatment B and from 1.597 to 1.415 for citrus drink treatment C. During storage in refrigerator at 6±2°C, the relative viscosity was decreased from 1.505 to 1.382 for citrus drink control, from 1.592 to 1.415 for citrus drink treatment A, from 1.593 to 1.392 for citrus drink treatment B and from 1.597 to 1.415 for citrus drink treatment C. The decrement of viscosity for all treatments could be due to the nature and amount of pectin present as well as degradation of high molecule pectic substances to small fraction molecules of pectic substance *(Thakur et al., 1996)*.

Table (17) : Effect of storage periods and storage temperature on the relative viscosity for sport drink treatments

Storage periods (month) / Treatments	Storage at ambient temperature				Storage at 6±2°C			
	0	1	2	3	0	2	4	6
Control	1.515	1.500	1.482	1.375	1.515	1.504	1.493	1.382
A	1.595	1.522	1.493	1.403	1.592	1.532	1.505	1.415
B	1.593	1.519	1.485	1.392	1.596	1.522	1.493	1.400
C	1.597	1.527	1.493	1.415	1.598	1.531	1.498	1.424

Control : Citrus blend drink with 20% sucrose

A : Citrus blend drink with 10% sucrose, 5% sweet condensed milk and 10% honey

B : Citrus blend drink with 5% glucose, 5% fructose, 5% sweet condensed milk and 10% honey.

C : Citrus blend drink with 2.5% sucrose, 5% glucose, 2.5% fructose, 5% sweet condensed milk and 10% honey

Figure (37) Relative viscosity of sport drinks treatments

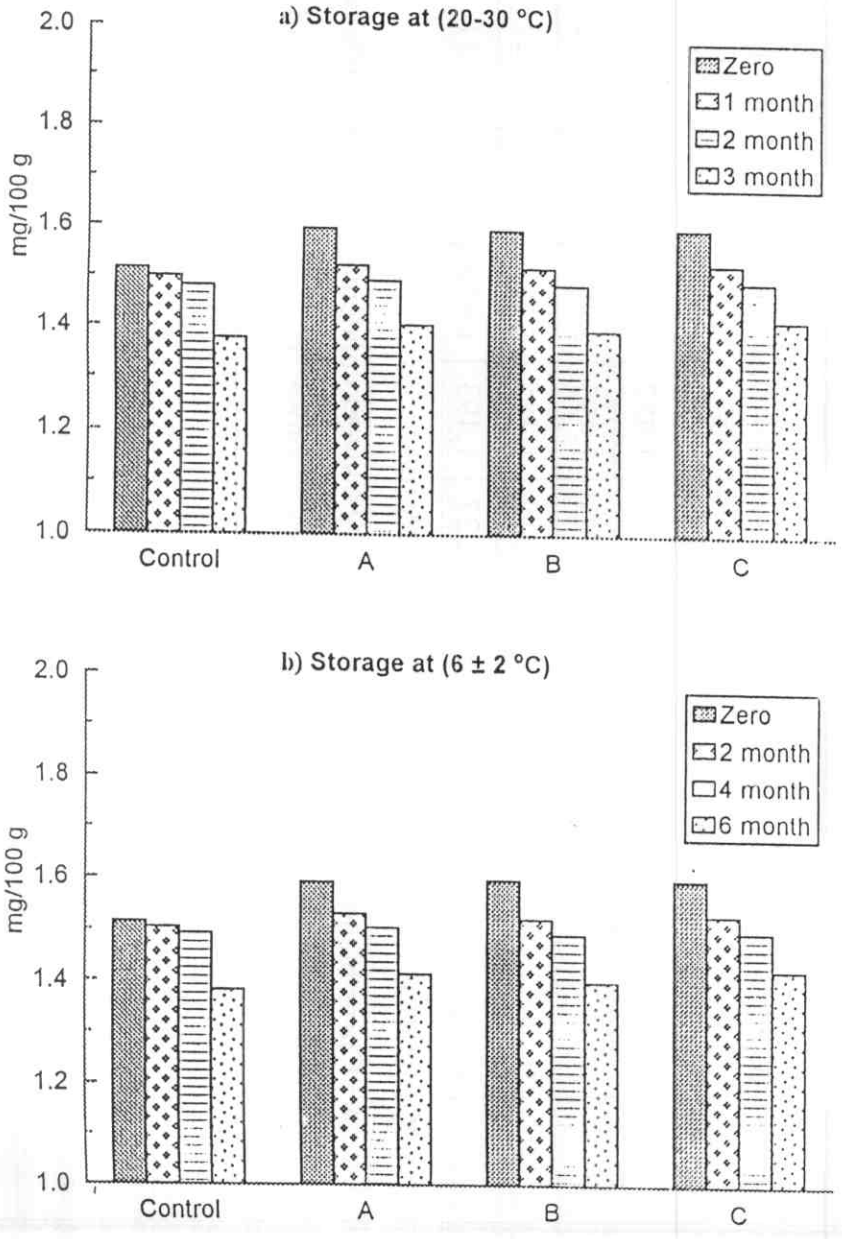


Table (18) : Effect of storage periods and storage temperature on microbiological examination for sport drink treatments

Storage Periods (month) / Treatments		Total bacterial count				Mould & Yeast				Coliform			
		0	**1**	**2**	**3**	**0**	**1**	**2**	**3**	**0**	**1**	**2**	**3**
Ambient temperature	Control	50<	20<	20<	10<	10<	10<	0	0	0	0	0	0
	A	50<	20<	20<	10<	10<	0	0	0	0	0	0	0
	B	50<	20<	10<	0	0	0	0	0	0	0	0	0
	C	50<	20<	10<	0	0	0	0	0	0	0	0	0
		0	**2**	**4**	**6**	**0**	**2**	**4**	**6**	**0**	**2**	**4**	**6**
Cold storage	Control	50<	20<	10<	0	10<	10<	0	0	0	0	0	0
	A	50<	10<	10<	0	10<	0	0	0	0	0	0	0
	B	50<	10<	10<	0	0	0	0	0	0	0	0	0
	C	50<	10<	10<	0	0	0	0	0	0	0	0	0

Control : Citrus blend drink with 20% sucrose

A : Citrus blend drink with 10% sucrose, 5% sweet condensed milk and 10% honey

B : Citrus blend drink with 5% glucose, 5% fructose, 5% sweet condensed milk and 10% honey.

C : Citrus blend drink with 2.5% sucrose, 5% glucose, 2.5% fructose, 5% sweet condensed milk and 10% honey.

Table (19) : Organoleptic evaluation of sport drink treatments during storage for 3 months at ambient temperature (20-30°C)

Treatments	Storage period	Color	Taste	Odor	Overall acceptability
Control	0	19.5	19.0	18.8	38.9
	1	19.1	18.5	18.5	38.3
	2	19.0	18.1	18.0	37.6
	3	18.6	17.9	17.7	36.6
Mean		19.0	18.3	18.2	37.8
A	0	19.1	19.3	19.0	38.6
	1	19.0	19.0	18.5	38.2
	2	18.7	18.5	18.0	37.8
	3	18.2	18.0	17.5	37.4
Mean		18.7	18.7	18.2	38.0
B	0	19.1	19.2	19.1	39.5
	1	18.8	19.0	18.8	39.2
	2	18.1	18.7	18.7	38.8
	3	17.9	18.3	18.2	38.1
Mean		18.4	18.8	18.7	38.9
C	0	18.9	19.0	19.0	39.2
	1	18.7	18.8	18.7	38.7
	2	18.0	18.4	18.3	38.1
	3	17.6	18.0	17.8	37.6
Mean		18.3	18.5	18.4	38.4

Control : Citrus blend drink with 20% sucrose
A : Citrus blend drink with 10% sucrose, 5% sweet condensed milk and 10% honey
B : Citrus blend drink with 5% glucose, 5% fructose, 5% sweet condensed milk and 10% honey.
C : Citrus blend drink with 2.5% sucrose, 5% glucose, 2.5% fructose, 5% sweet condensed milk and 10% honey

Table (20) : Organoleptic evaluation of sport drink treatments during storage for 6 months in refrigerator (6±2°C)

Treatments	Storage period	Color	Taste	Odor	Overall acceptability
Control	0	19.5	19.1	18.9	39.0
	2	19.2	18.6	18.6	38.5
	4	19.1	18.3	18.1	37.7
	6	18.7	18.0	17.8	36.7
Mean		19.1	18.5	18.3	37.9
A	0	19.2	19.3	19.1	38.7
	2	19.1	19.0	18.7	38.4
	4	18.8	18.6	18.1	38.0
	6	18.3	18.1	17.6	37.5
Mean		18.8	18.7	18.3	38.1
B	0	19.2	19.3	19.2	39.6
	2	18.9	19.1	18.9	39.3
	4	18.3	18.8	18.7	38.9
	6	18.0	18.4	18.3	38.2
Mean		18.6	18.9	18.7	39.0
C	0	19.0	19.1	19.1	39.3
	2	18.8	18.9	18.8	38.8
	4	18.1	18.5	18.4	38.2
	6	17.8	18.1	17.9	37.8
Mean		18.4	18.6	18.5	38.5

Control : Citrus blend drink with 20% sucrose

A : Citrus blend drink with 10% sucrose, 5% sweet condensed milk and 10% honey

B : Citrus blend drink with 5% glucose, 5% fructose, 5% sweet condensed milk and 10% honey.

C : Citrus blend drink with 2.5% sucrose, 5% glucose, 2.5% fructose, 5% sweet condensed milk and 10% honey.

Figure (38) Mean score values of sport drinks treatments

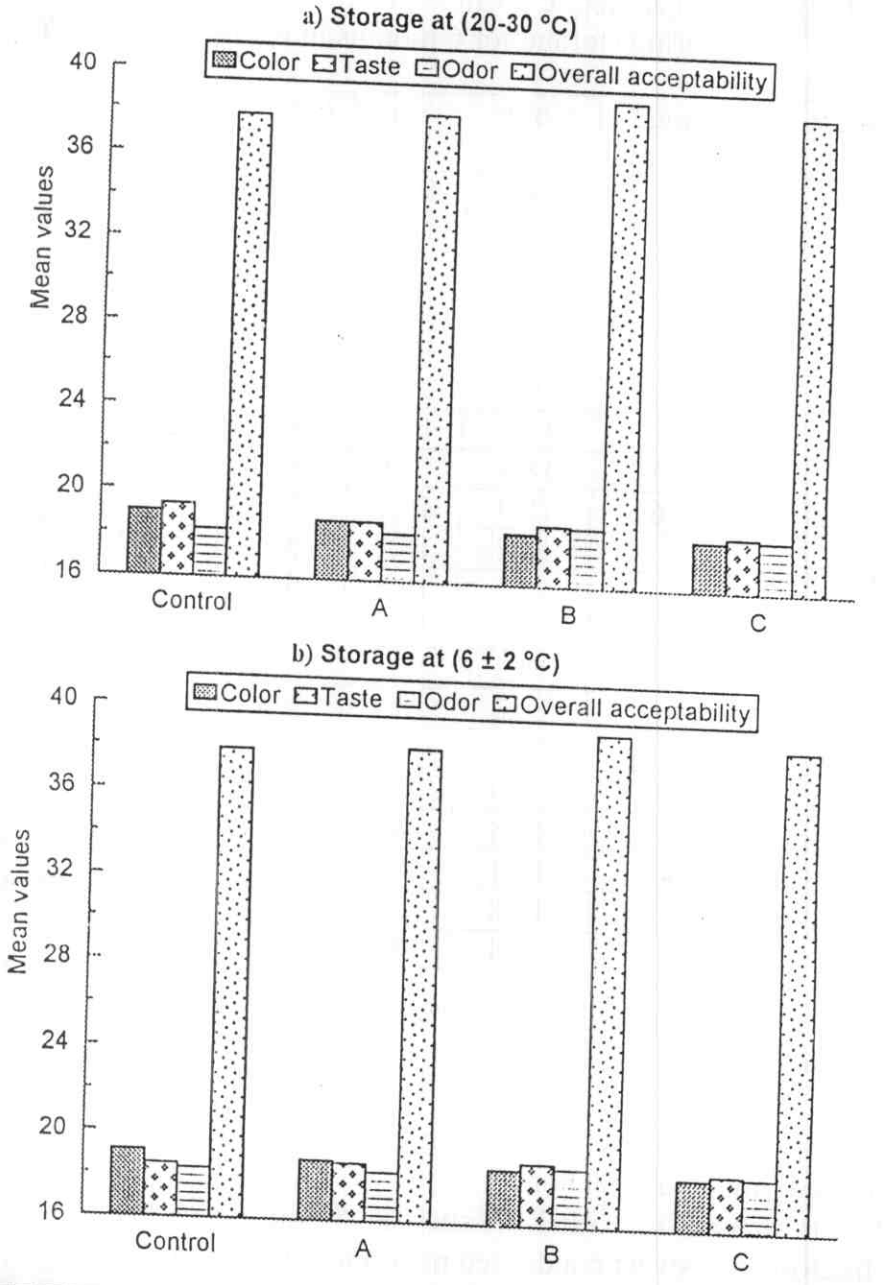


Table (21) : Least significant differences (L.S.D 0.05) of organoleptic evaluation of sport drink treatments during storage.

Variance	Color	Taste	Odor	Overall acceptability
(1) Treatment	0.1063	0.1210	0.0965	0.1210
(2) Storage	0.1504	0.1711	0.1365	0.1711
Interaction between (1) and (2)	0.3008	0.3422	0.2729	0.3422

4.3.12 Microbiological examination :

The obtained lower bacterial load could be attributed to the various factors. So the processed citrus drink treatments for sports were carried out automatically for each step as follows : sorted fruits were cut, squeezed to juice, homogenized, pasteurized, mixed with different materials, homogenized, pasteurized and packed. The data obtained from Table (18) showed that total bacterial counts ranged from 0 to less than 50 / 1g, mould and yeast ranged from 0 to 10/1g, for all citrus drink treatments during storage at room temperature (20—30°C) and refrigerator (6±2°C). This may be due to good sanitation conditions and automatic steps during processing and subsequent storage. The data in the same table also show that coliform group was absent this due to the good sanitation during processing and the added water to citrus blend juice was free from coliform group.

4.3.13 Organoleptic evaluation :

Overall evaluation of most of the citrus drink treatments for sports performed throughout the present study from the point of organoleptic properties was carried out with the aid of trained judges. Scores were given for color, taste, odour and overall acceptability to make the final score out of 100 for 4 samples of citrus drink during storage at room temperature (20-30°C) and in refrigerator at (6±2°C) (Tables 19 & 20) and Figures (38 & 39). With respect to the taste attribute of the tested samples, the obtained data in Tables (19 & 20) and Figures (37 & 38) show that the color score of citrus drink control was slight higher than

that in citrus drink treatments, this may be due to addition of honey and sweet condensed milk change the color from yellowish. But taste, odour and overall acceptability the citrus drink treatments were slight higher than citrus drink control. During storage at room temperature (20-30°C) and in refrigerator at (6±2°C) all treatments under tests for color, taste, odour and overall acceptability were decreased gradually.

Data from Table (21) indicate the least significant difference (L.S.D) at 0.05 of all stored treatment for color, taste, odour and overall acceptability.