RESULTS AND DISCUSSION

II. Chemical composition of different types of *Mozzarella* cheese:

Data presented in **Table (12)** show the chemical composition of different Mozzarella cheese treatments.

1- Moisture content and Moisture-on-fat-free basis (MFFB):

The moisture content of Mozzarella cheese made from cows' milk was higher than that of standardized buffaloes' milk. Generally, fresh UF- cows' Mozzarella cheese (T2) contained higher moisture than other treatments. The average moisture contents of fresh Mozzarella cheese were 45.88, 48.78, 45.03, 46.43, 46.58 and 46.87 % for treatments T1 to T6, respectively. The obtained results may be due to ability of casein in cows' milk to bound more water than buffaloes' casein which attributed to the characteristic of casein micelles and mineral salts of buffaloes' milk. This is in agreement with the trends given by **Abd El-Kader (1993)** and **Abd El-Gawad (1998)** and with results in part I.

After one month of refrigiration storage, there was a noticeable decrease in moisture content of all Mozzarella cheese samples, reaching to be 43.94, 46.13, 43.15, 44.21, 44.36 and 44.51% for tratments T1 to T6, in sequence. Treatments T4, T5 and T6 had the highest moisture content. This may be attributed to using the brine solution as a stretching water, which led the curd to keep more moisture in their structure.

In general, the moisture content of fresh and ripened Mozzarella cheese ranged from 45.03 to 48.78 % and 43.15 to 46.13 %, respectively. Thus, the moisture content of all fresh cheese treatments are within the **Fedral Standards** for low moisture Mozzarella (< 52 %). Also, it met the **Egyptain Legal Standards (2005)** for part skimmed Mozzarella cheese (Not more than 57 %).

The moisture content in this study within the range reported by **El-Batawy *et al.* (2004)**, for Mozzarella cheese.

Statistical analysis showed that, moisture content of Mozzarella cheese was significant as it was affected by the replication, treatments and storage period ***(P< 0.0001)*** with LSD = 0.361 and 0.209 for treatments and storage period, respectively.

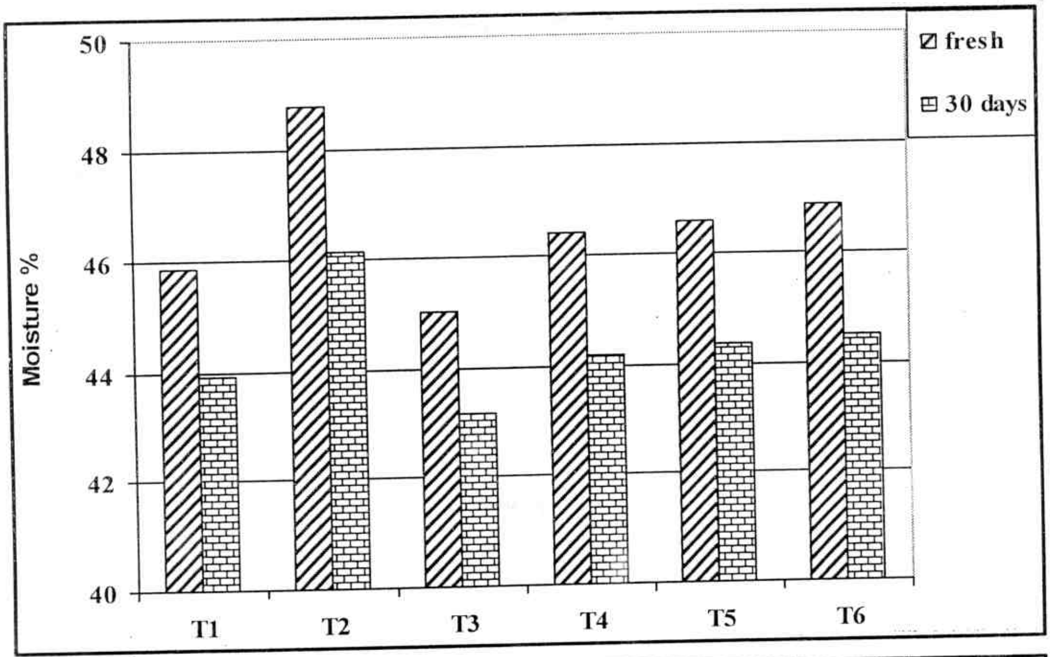
The changes in MFFB% among all treatments took the same trends as moisture, which was decreased after the storage period up to 30 days, which can be attributed to some moisture evaporation during storage. The results revealed that, fresh UF-cows' Mozzarella cheese had higher MFFB% than other treatments. The average of MFFB% was 58.08, 61.36, 56.78, 58.48, 58.59 and 58.88 % in fresh Mozzarella cheese for T1 to T6, respectively. The MFFB % results in all treatments ranged from 54.97 to 61.36 % which are within the same classification scheme of **Codex Standards -1978** of semi hard cheeses (54-69%).

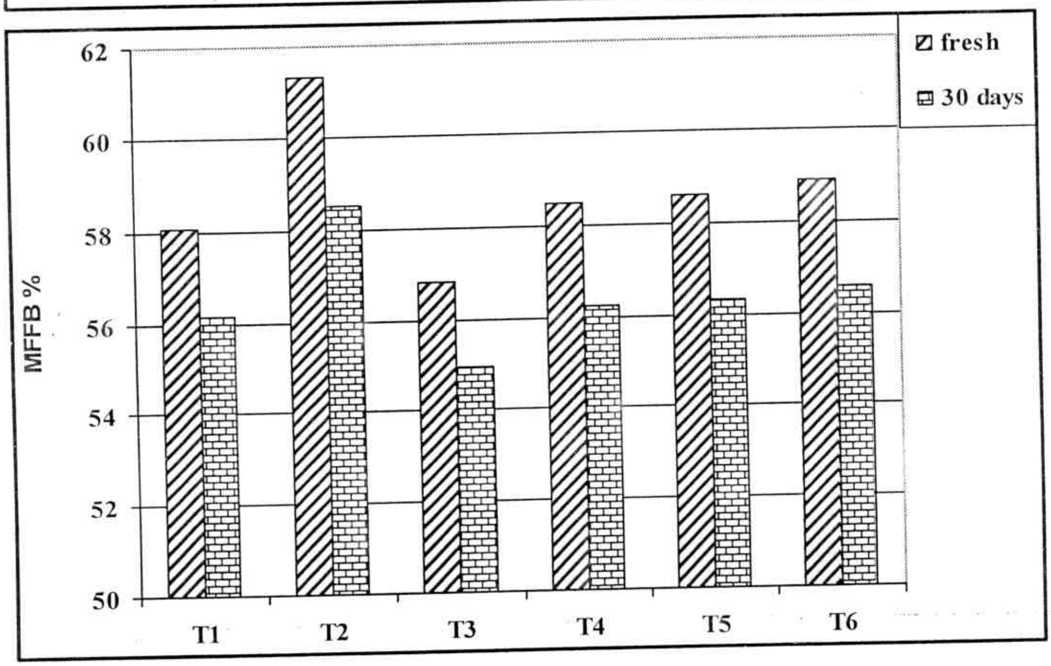
Table (12) Gross chemical composition of Mozzarella cheese from different treatments.

Treatments		Moisture %	Moisture MFFB %	Fat %	Fat / DM %	Salt %	Salt S/M %	Ash %	Lactose %
T1	Fresh	45.88	58.08	21.0	38.80	1.22	2.66	2.95	2.59
T2	Fresh	48.78	61.36	20.5	40.02	1.23	2.52	3.01	3.24
T3	Fresh	45.03	56.78	20.7	37.66	1.27	2.82	3.21	3.31
T4	Fresh	46.43	58.48	20.6	38.45	1.14	2.46	3.08	2.48
T5	Fresh	46.58	58.59	20.5	38.37	1.17	2.51	3.12	2.41
T6	Fresh	46.87	58.88	20.4	38.39	1.19	2.54	3.13	2.26
T1	30 days	43.94	56.12	21.7	38.71	1.37	3.12	3.31	0.97
T2	30 days	46.13	58.54	21.2	39.99	1.41	3.06	3.21	1.09
T3	30 days	43.15	54.97	21.5	37.82	1.41	3.27	3.54	1.26
T4	30 days	44.21	56.25	21.4	38.36	1.21	2.74	3.51	0.6
T5	30 days	44.36	56.37	21.3	38.28	1.24	2.80	3.53	0.52
T6	30 days	44.51	56.56	21.3	38.39	1.29	2.90	3.57	0.61

MFFB: Moisture-on – fat-free basis DM: Dry Matter S/M: Salt –in- moisture content

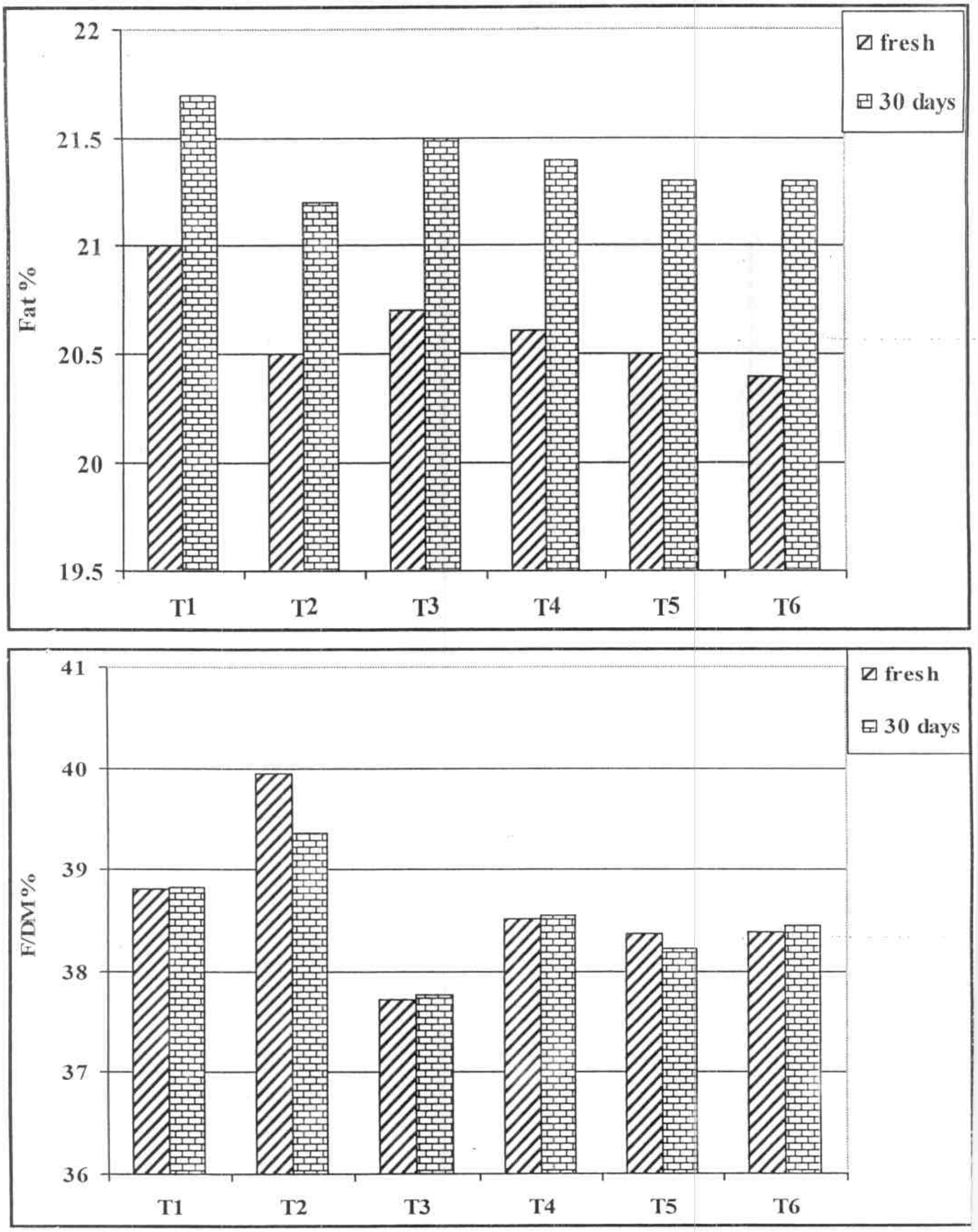
T1: Control standardized buffaloes' milk
T2: Control Cows' retentate
T3: Control Buffaloes' retentate
T4: Buffaloes' retentate stretched in 1% brine solution
T5: Buffaloes' retentate stretched in 2% brine solution
T6: Buffaloes' retentate stretched in 3% brine solution





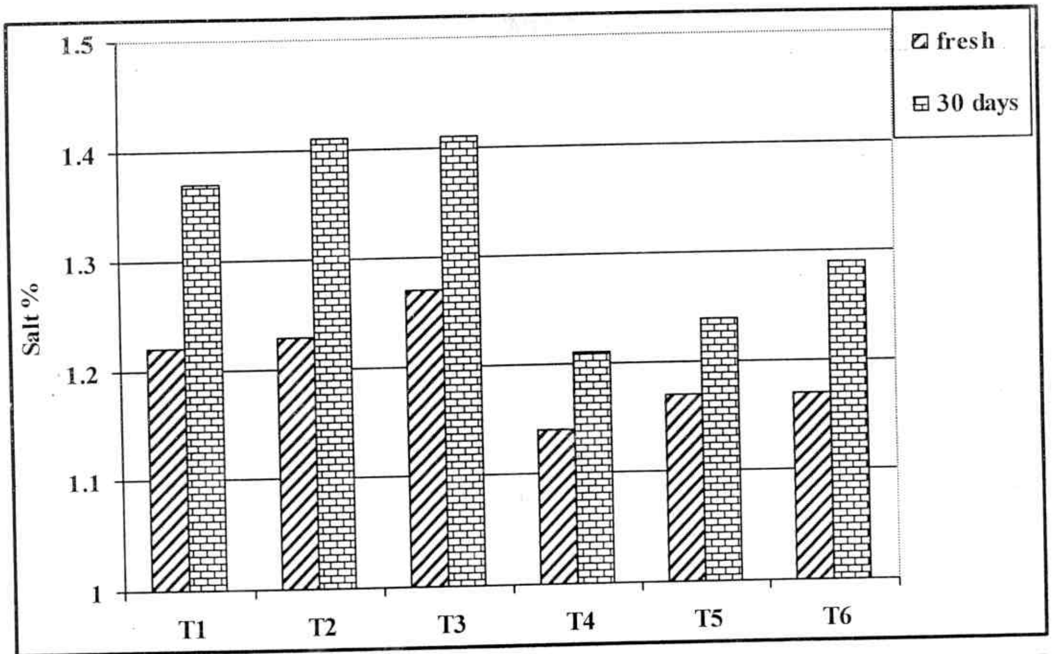
T1: Control standardized buffaloes' milk
T2: Control Cows' retentate
T3: Control Buffaloes' retentate
T4: Buffaloes' retentate stretched in 1% brine solution
T5: Buffaloes' retentate stretched in 2% brine solution
T6: Buffaloes' retentate stretched in 3% brine solution

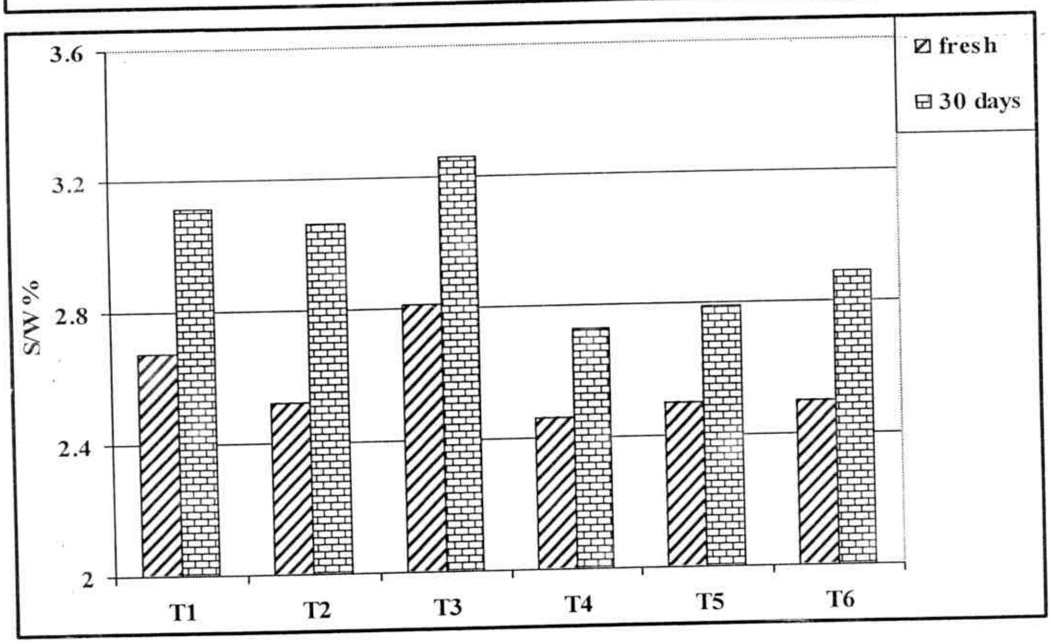
Fig (13) Moisture and MFFB contents of different types of Mozzarella cheese.



T1: Control standardized buffaloes' milk
T2: Control Cows' retentate
T3: Control Buffaloes' retentate
T4: Buffaloes' retentate stretched in 1% brine solution
T5: Buffaloes' retentate stretched in 2% brine solution
T6: Buffaloes' retentate stretched in 3% brine solution

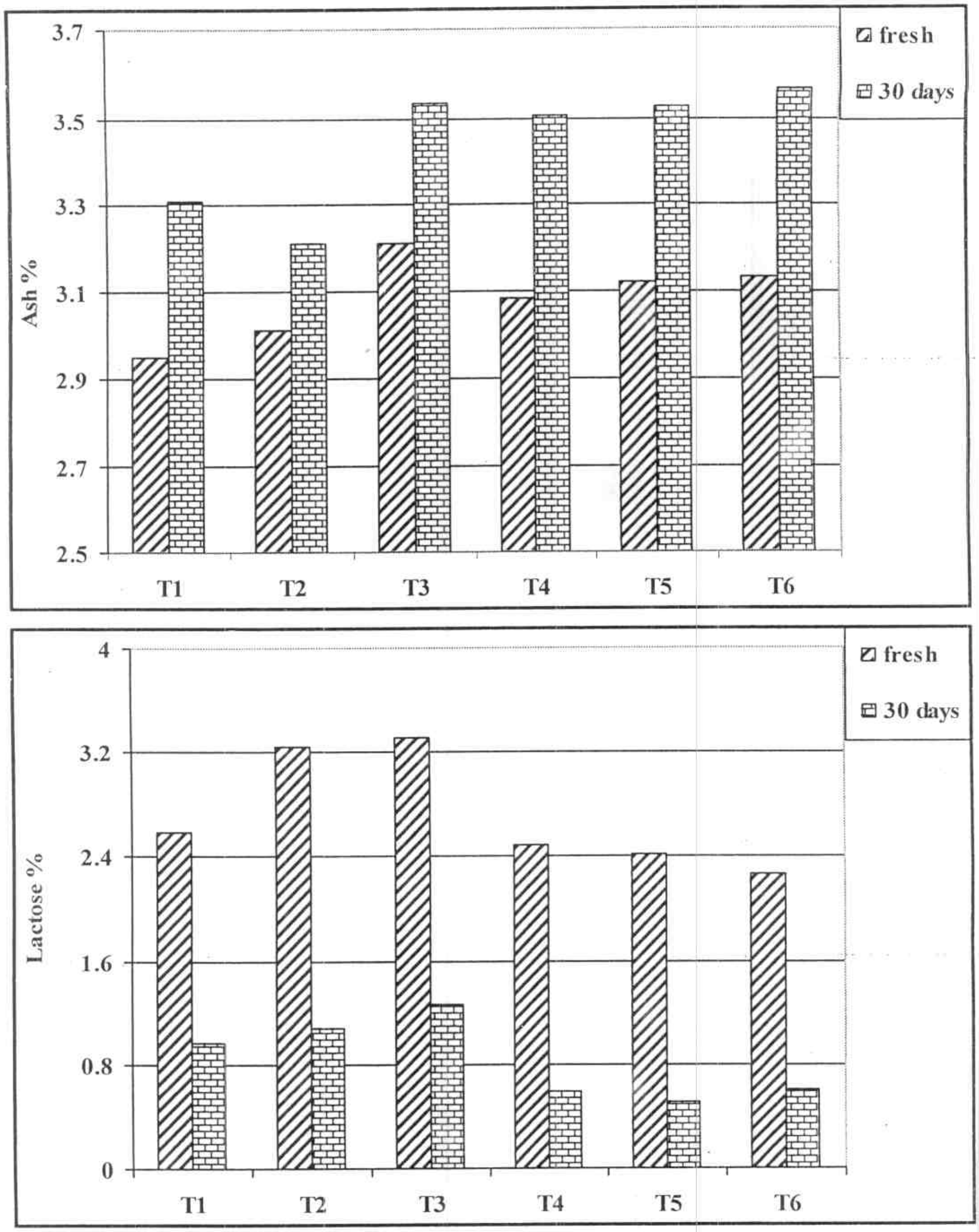
Fig (14) Fat % and F/DM % of different types of Mozzarella cheese.





T1: Control standardized buffaloes' milk
T2: Control Cows' retentate
T3: Control Buffaloes' retentate
T4: Buffaloes' retentate stretched in 1% brine solution
T5: Buffaloes' retentate stretched in 2% brine solution
T6: Buffaloes' retentate stretched in 3% brine solution

Fig (15) Salt % and S/M% contents of different types of Mozzarella cheese.



T1: Control standardized buffaloes' milk
T2: Control Cows' retentate
T3: Control Buffaloes' retentate
T4: Buffaloes' retentate stretched in 1% brine solution
T5: Buffaloes' retentate stretched in 2% brine solution
T6: Buffaloes' retentate stretched in 3% brine solution

Fig (16) Ash and Lactose % of different types of Mozzarella cheese.

It was also noticed that, treatment T2 had the highest MFFB percent, this could be attributed to the ability of casein in cows' milk to bound more water than buffaloes' casein, this will affect the characteristic of casein micelles and mineral salts of buffaloes' milk. The obtained results were in agreement with the trends given by Abdel Kader (1993).

Statistical analysis of MFFB % of all Mozzarella cheese treatments was significant as it was affected by replication, treatment, and storage period ***($P < 0.0001$)*** with LSD = 0.448 and 0.259 for treatment and storage period, respectively.

3- Fat content and F/DM %:

From the results of fat content and F/DM% of Mozzarella cheese treatments, it could be observed that fat and F/DM% slightly increased after storage period. This may be due to the gradual loss of moisture during storage period **(El-Zoghby, 1994; Anis, 1979, and Hagrass *et al.*, 1984).** The results also indicated that UF-treatments had less fat content in fresh cheeses, than the traditional fresh cheeses and after one month of storage. The average of fat content in fresh samples was 21.0, 20.5, 20.7, 20.6, 20.5 and 20.4% for the treatments T1 to T6, reached to be 21.7, 21.2, 21.5, 21.4, 21.3 and 21.3%, in the same order, after the storage period. The fat content and F/DM results are in accordance with the findings of **Saleh, (1997)** and **El-Batawy *et al.* (2004).**

Generally, the F/DM of all treatments ranged from 37.66 to 40.02 % in both fresh and ripened cheese. These results lie within the **Egyptain Legal Standards (2005)** for part skimmed (3/4 F) Mozzarella cheese (35-45 %).

Statistical analysis showed that, fat content and F/DM of all Mozzarella cheese treatments are significantly affected by treatment and storage period ***(P < 0.0001)*** with LSD = 0.164 and 0.095 in sequence. Also, F/DM was affected by replication, treatment and storage period ***(P < 0.0001)*** with LSD 2.057 and 1.187 for treatments and storage period, respectively.

4- Salt and salt–in–moisture (S/M) content:

The changes in salt content and salt–in–moisture (S/M %) of Mozzarella cheese produced from standardized buffaloes' milk or UF-cows' and buffaloes' retentates cleared that the salt content increased during cheese storage in all treatments. There was a noticeable variation between treatments in salt content and S/M %. The salt content was 1.22, 1.23, 1.27, 1.14, 1.17 and 1.19 % in fresh cheeses T1 to T6, respectively and increased after storage to be a level of 1.37, 1.41, 1.41, 1.21, 1.24 and 1.29 % for treatments T1 to T6, in sequence. The corresponding S/M % were 2.66, 2.52, 2.82, 2.46, 2.51 and 2.54 % of treatments T1 to T6, respectively and increased to be 3.12, 3.06, 3.27, 2.74, 2.80 and 2.90 % of treatments T1, T2, T3, T4,T5 and T6, in the same order after storage period.

These results are lower than those given by **El-Batawy *et al.* (2004)**; but was within the range given by Nilson and LaClair (1976) who observed a wide range of salt content from 1.0 to 4.5 % in Mozzarella cheese.

Variations in salt content and S/M % can be attributed to the different methods of brining. In treatments T4, T5 and T6, the curd was stretched with 1, 2 and 3 %, brine respectively which was completly different than control cheeses (treatments T1, T2 and T3). This agree with **Fernandez and Kosikowski (1986)** who concluded that curd stretched in hot brine contained less salt than when stretched in hot water.

Statistical analysis illustrated that, salt content and S/M % of Mozzarella cheese were affected by replication, treatment and storage period, ***(P < 0.0001)*** with LSD = 0.086, 0.049 & 0.179, 1.103 for treatment and storage period of salt and S/M %, respectively.

5- Ash content:

As it can be seen from **Table (12) and Fig (16)** which illustrated by statistical analysis that UF-buffaloes' cheese had the highest ash content when fresh, followed by treatments T6, T5, T4, T1 and T2, respectively. The ash contents was 2.95, 3.01, 3.21, 3.08, 3.12 and 3.13 % when fresh samples which, increased during storage to be 3.31, 3.21, 3.54, 3.51, 3.53 and 3.57%. Such increase could be attributed to moisture loss during storage as a result of evaporation **(Geurts *et al.*, 1980).** These results are in the vicinity with the findings of **El-Batawy *et al.* (2004)** who found that ash content ranged from 2.13-3.01%.

It was observed that ash content of Mozzarella cheese stretched in hot brine (treatments T4, T5 and T6) was lower than the control (treatment T3). This is in accordance with **Fernandez and Kosikowski (1986).**

Analysis of variance shows that ash content of all Mozzarella cheese treatments are affected by treatments and storage period ***(P < 0.0001)*** with LSD = 0.133 and 0.077, respectively.

6- Lactose contents:

The changes in lactose content of all Mozzarella cheese samples are illustrated in **Table (12).** The results revealed that, there are a noticeable differences in lactose contents between treatments either when fresh or after storage period. UF–buffaloes' Mozzarella cheese (T3) contained the highest lactose content and followed by treatments T2, T1, T4, T5 and T6, respectively. Most of lactose in all samples were metabolized during storage, mainly through the activity of the starter bacteria and this is differed among different treatments.

Lactose values were 2.59, 3.24, 3.31, 2.48, 2.41 and 2.26 % in the fresh samples for T1 to T6, respectively and decreased to be

0.97, 1.09, 1.26, 0.60, 0.52 and 0.61 % after 30 days of storage at ≃ 5 °C, in the same order. Because the lactose is calculated by differences, the variation of lactose content may be due to somewhat defects in the determination methodology of other cheese components which reflected the most variations.

Analysis of variance shows that, lactose contents in all Mozzarella cheese treatments were significantly affected by the replication, treatments, storage period and the interaction between treatments and storage period ***($P < 0.0001$)*** with LSD of 0.059 and 0.035 for treatment and storage period, respectively.

7- Total Protein (TP) content:

Total protein content of Mozzarella cheese were lower in UF-cows' Mozzarella cheese than that in traditional and UF-standardized buffaloes' treatments (T3, T4, T5 and T6). The average of total nitrogen content of fresh Mozzarella cheese was 27.58, 24.47, 27.75, 27.41, 27.39 and 27.34 % for treatments T1 to T6, respectively. As it expected, the UF-buffaloes' cheese had the highest TP, which is matching the findings of many workers. This is due to the concentration of casein and retaining of whey proteins in the retentates by the ultrafiltration technique. Similar results were obtained by **Fernandez and Kosikowski (1986)** and **El-Batawy *et al.* (2004).** The difference between TP content in treatment T3 and other buffaloes' retentate cheese treatments T4, T5 and T6 may be due to the difference in TS as it was higher in TS content. A gradual increase in total protein was observed in all samples of different treatments after one month of storage as they reached to 30.08, 28.37, 30.55, 30.28, 30.29 and 30.01 %, in the same order. The increase of total protein content throughout storage may be due to the decrease of the moisture content. These results are confirmed by that obtained by **El-Batawy *et al.* (2004)** and the results of part I.

Statistical analysis revealed that, there was significant differences in total protein content of Mozzarella cheese ***($P < 0.0001$)*** with LSD 0.044 and 0.025 for treatment and storage period, respectively.

8- Soluble nitrogen (SN) and SN/TN %:

In this respect, the change of soluble nitrogen (SN) and SN/TN % of different Mozzarella cheese treatments when fresh and after the storage period reflects the rate of proteolysis generally as it was increased after one month of storage. SN recorded (0.152 & 0.271), (0.235& 0.339), (0.164 & 0.278), (0.184 & 0.319), (0.228 & 0.345) and (0.207& 0.338 %) in Mozzarella cheese treatments from T1 to T6, fresh & stored, consecutively. These results revealed that SN content and SN/TN % were higher in UF-Mozzarella cheese treatments than that of traditional one. The higher SN content and SN/TN % may be due to the presence of whey proteins in the retentates of these cheeses. On the other hand, UF–Mozzarella cheese treatments (T2, T3, T4, T5 and T6), produced using yoghurt culture + *Bifidobacteria Bb–12*) showed a higher SN and SN/TN %, which may be reflects the ability of the modified starter to hydrolyse the denaturated whey proteins.

Finally, the protein degradation in UF-Mozzarella cheese treatments was significantly greater and faster than traditional one, which may be due to the addition of the modified starter containing *Bifidobacteria* which may be had an advantage over the yoghurt starter culture. The SN/TN % of Mozzarella cheese when fresh and after one month of storage recorded (3.52 & 5.75), (6.13 & 7.62), (3.77 & 5.80), (4.28 & 6.72), (5.31& 7.27) and (4.83 & 7.19%) in the treatments T1 to T6, respectively.

UF-cows' Mozzarella cheese recorded the highest SN content (treatment T2). This was expected because cows' casein degradation is faster than that of buffaloes'. Also, the SN/TN was the highest in the same treatment as a result of the great reduction in the TN.

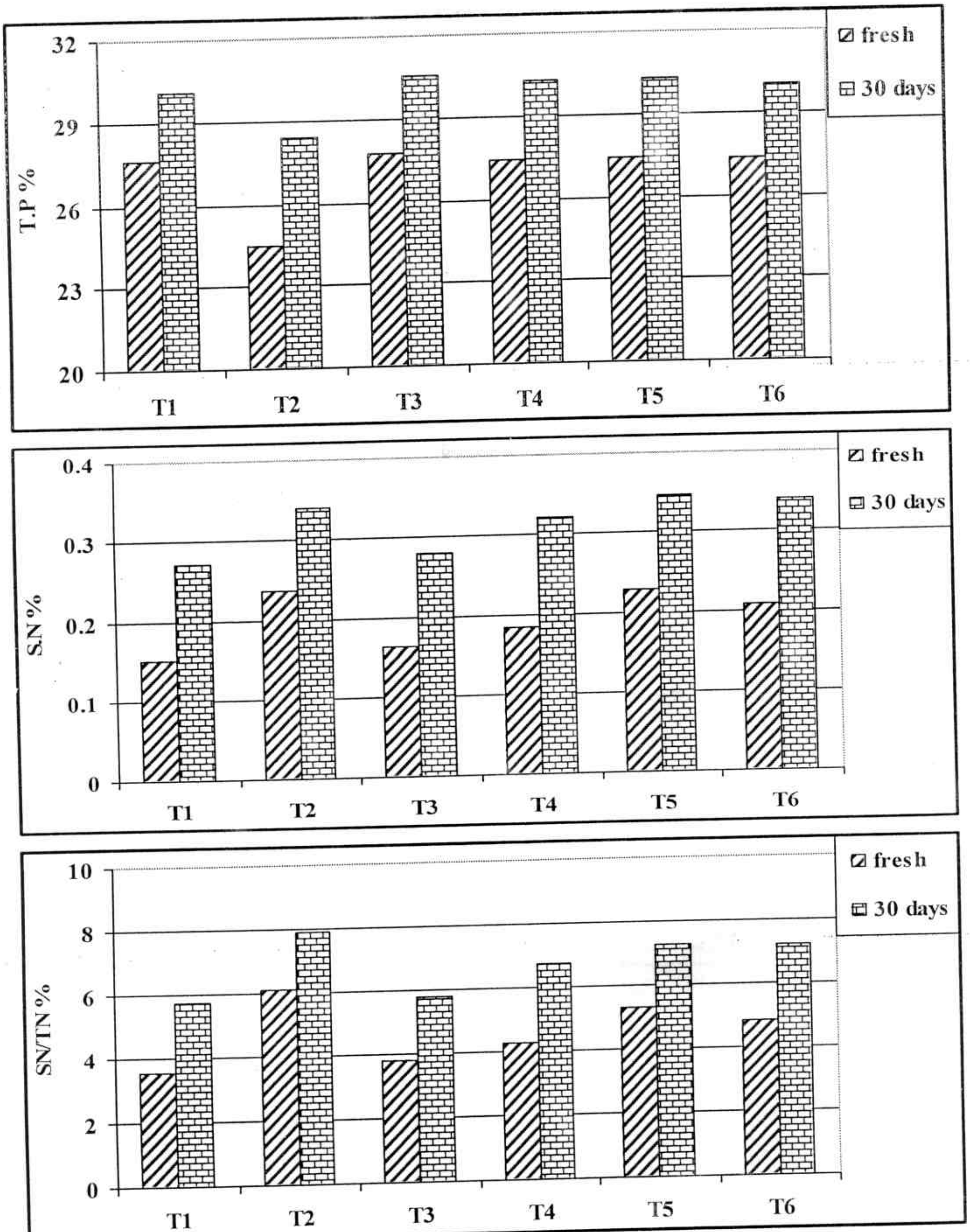
Analysis of variance illustrates that soluble nitrogen (SN) content of all Mozzarella cheese treatments were affected by treatment ***(P < 0.0001)*** with LSD 0.018 and 0.011 for treatment and storage period, respectively. Howevere, SN/TN % were affected by replication, treatment and storage period ***(P < 0.0001)*** with LSD = 0.504 and 0.291 in the same previous order.

Table (13) Protein fractions, Ca%, Ca/DM %, P%, P/DM%, TA% and p

values of Mozzarella cheese from different treatments.

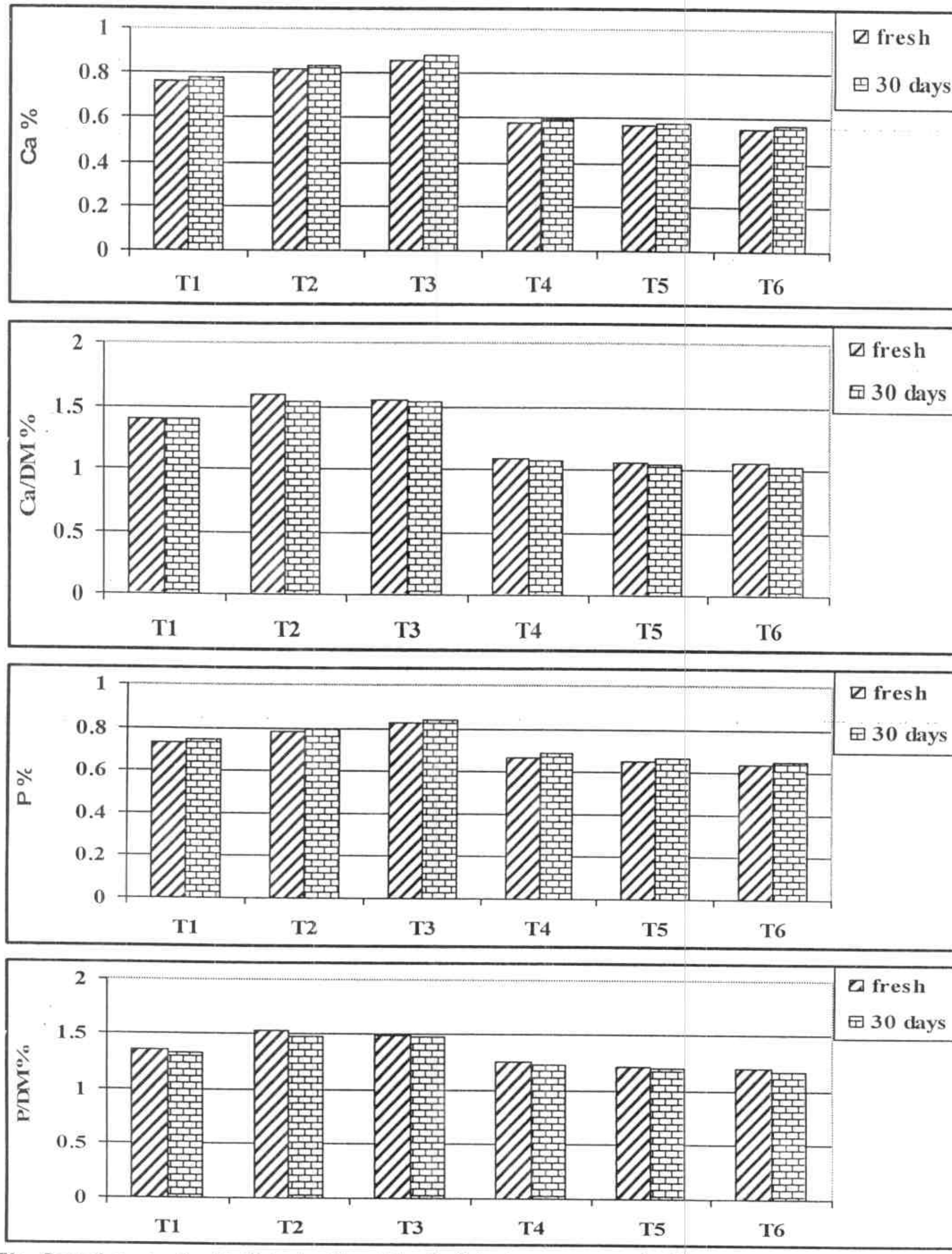
Treat-ments		T.N %	T P %	S.N %	SN/ TN %	Ca %	Ca /DM %	P %	P /DM %	TA %	p va
T1	Fresh	4.323	27.58	0.152	3.52	0.759	1.40	0.732	1.35	0.74	5.
T2	Fresh	3.836	24.47	0.235	6.13	0.819	1.59	0.786	1.53	0.73	5.
T3	Fresh	4.349	27.75	0.164	3.77	0.854	1.55	0.828	1.49	0.65	5.
T4	Fresh	4.297	27.41	0.184	4.28	0.582	1.09	0.667	1.25	0.64	5
T5	Fresh	4.294	27.39	0.228	5.31	0.568	1.06	0.653	1.22	0.62	5
T6	Fresh	4.285	27.34	0.207	4.83	0.557	1.05	0.637	1.20	0.60	5
T1	30 days	4.714	30.08	0.271	5.75	0.779	1.39	0.745	1.33	0.95	5
T2	30 days	4.447	28.37	0.339	7.62	0.832	1.54	0.799	1.48	1.06	4
T3	30 days	4.789	30.55	0.278	5.80	0.877	1.54	0.839	1.48	0.99	5
T4	30 days	4.746	30.28	0.319	6.72	0.596	1.07	0.687	1.23	1.05	[illegible]
T5	30 days	4.747	30.29	0.345	7.27	0.581	1.04	0.669	1.20	1.07	[illegible]
T6	30 days	4.703	30.01	0.338	7.19	0.572	1.03	0.649	1.17	1.04	[illegible]

T1: Control standardized buffaloes' milk
T2: Control Cows' retentate
T3: Control Buffaloes' retentate
T4: Buffaloes' retentate stretched in 1% brine solution
T5: Buffaloes' retentate stretched in 2% brine solution
T6: Buffaloes' retentate stretched in 3% brine solution



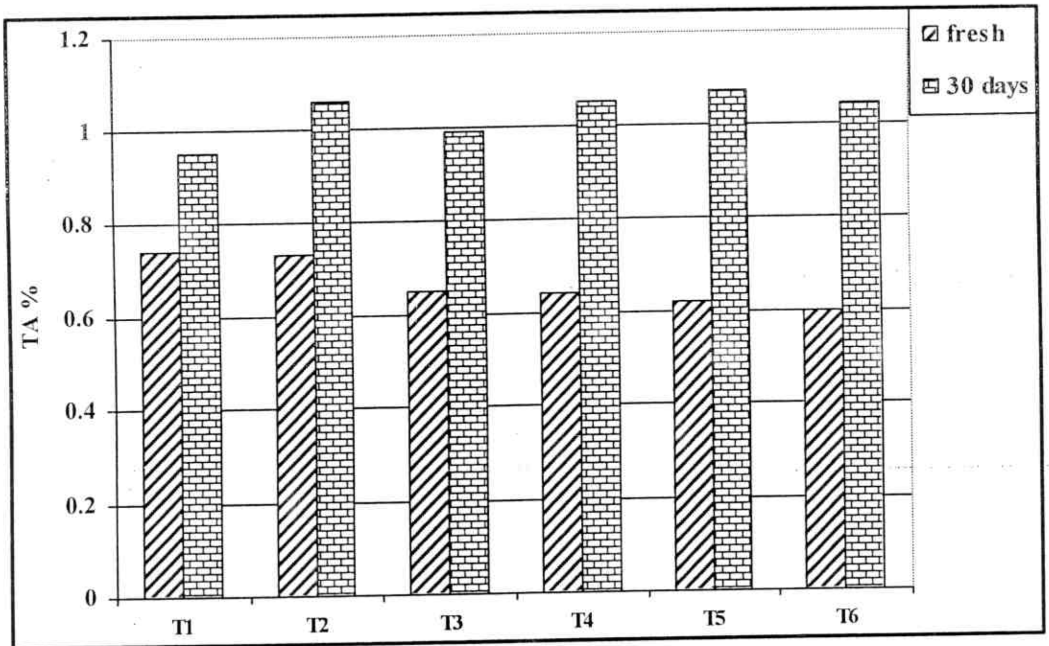
T1: Control standardized buffaloes' milk
T2: Control Cows' retentate
T3: Control Buffaloes' retentate
T4: Buffaloes' retentate stretched in 1% brine solution
T5: Buffaloes' retentate stretched in 2% brine solution
T6: Buffaloes' retentate stretched in 3% brine solution

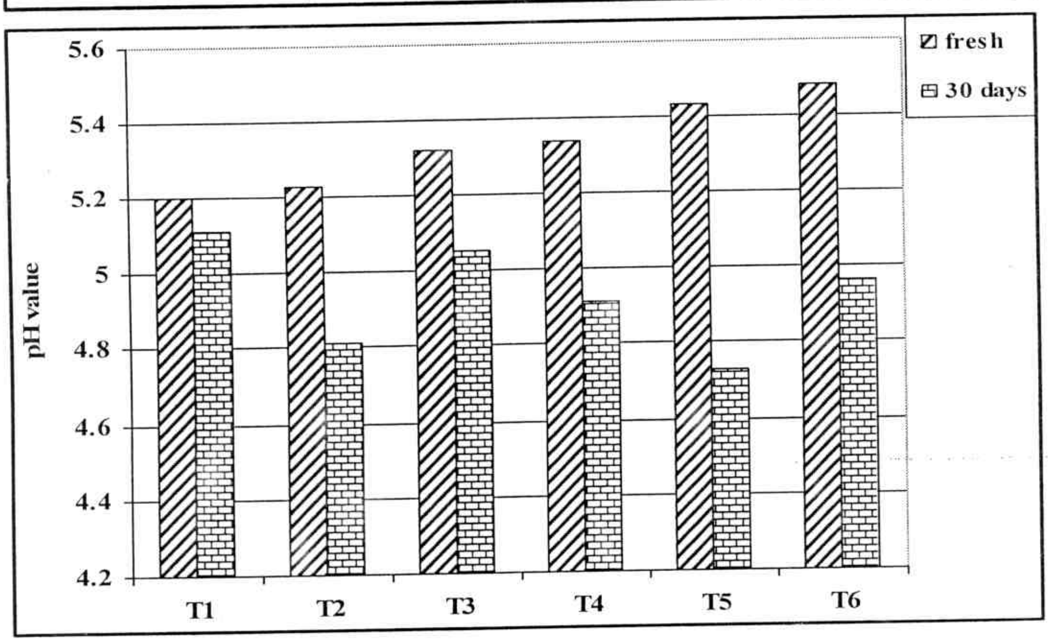
Fig (17) TP %, SN % and SN/TN % of different types of Mozzarella cheese



T1: Control standardized buffaloes' milk
T2: Control Cows' retentate
T3: Control Buffaloes' retentate
T4: Buffaloes' retentate stretched in 1% brine solution
T5: Buffaloes' retentate stretched in 2% brine solution
T6: Buffaloes' retentate stretched in 3% brine solution

Fig (18) Ca%, Ca/DM%, P% and P/DM % of different types of Mozzarella cheese





T1: Control standardized buffaloes' milk
T2: Control Cows' retentate
T3: Control Buffaloes' retentate
T4: Buffaloes' retentate stretched in 1% brine solution
T5: Buffaloes' retentate stretched in 2% brine solution
T6: Buffaloes' retentate stretched in 3% brine solution

Fig (19) Titratable acidity (TA %) and pH values of different types of Mozzarella cheese.

9- Calcium, Ca/DM, phosphorus and P/DM contents:

It was clear that Mozzarella cheese made from cows' or buffaloes' retentates had the highest calcium and phosphorus contents (0.819 and 0.854 % for calcium and 0.786; 0.828 % for phosphorus in fresh samples, respectively. The higher calcium and phosphorus contents of retentates is due to the concentration process, and that the casein, contains two third of the calcium and half of the phosphate as they are found closely linked to the casein as colloidal calcium phosphate **(Glover, 1985; Shmidt and Both, 1987).** While the non- miceller calcium phosphate is existed in the serum phase of the milk and can pass freely during ultrafiltration process. Mozzarella cheese made from cows' retentate contains higher Ca/DM than that made from standardized buffaloes' retentate which could be attributed to higher moisture content in the first one (48.78 %). Concerning to the other treatments (T4, T5 and T6) they had calcium and phosphorus contents less than the controls which may be attributed to using of 1, 2 and 3 % salt solution during stretching, the curd as the sodium replaced the calcium and phosphours in the curd. Calcium and phosphorus increased after 30 days storage reaching to a levels of 0.779 & 0.745, 0.832 & 0.799, 0.877 & 0.839, 0.596 & 0.687, 0.581 & 0.669 and 0.572 & 0.649 % in sequence.

Analysis of variance indicate that calcium, phosphorus, calcium percentage in dry matter and phosphorus percentage in dry matter affected by replication, treatment and storage period *(P < 0.0001)* respectively, with LSD 0.009 and 0.006 for calcium, and 0.036 and 0.021 for Ca/DM; 0.004 and 0.003 for phosphorus and 0.041 and 0.024 for P/DM of treatment and storage period, respectively.

10- Titratable acidity % and pH value:

The titratable acidity of traditional and all UF–Mozzarella cheese obtained from different treatments increased after storage period **(Fig 19)**, while the pH decreased. This could be attributed to acid producing activity of starter cultures which cause lactose fermentation and production of lactic acid during storage. these results are coincided with those of **Abdel-Gawad (1998), Yun *et al.* (1998), Zammar (2000)** and **Badawi *et al.* (2004).** The titratable acidity of traditional Mozzarella cheese was higher than that of UF-Mozzarella cheeses. This may be due to the higher buffering capacity of UF-cheese which influences bacterial starters activity. The pH took the same trend of TA but with an opposite direction.

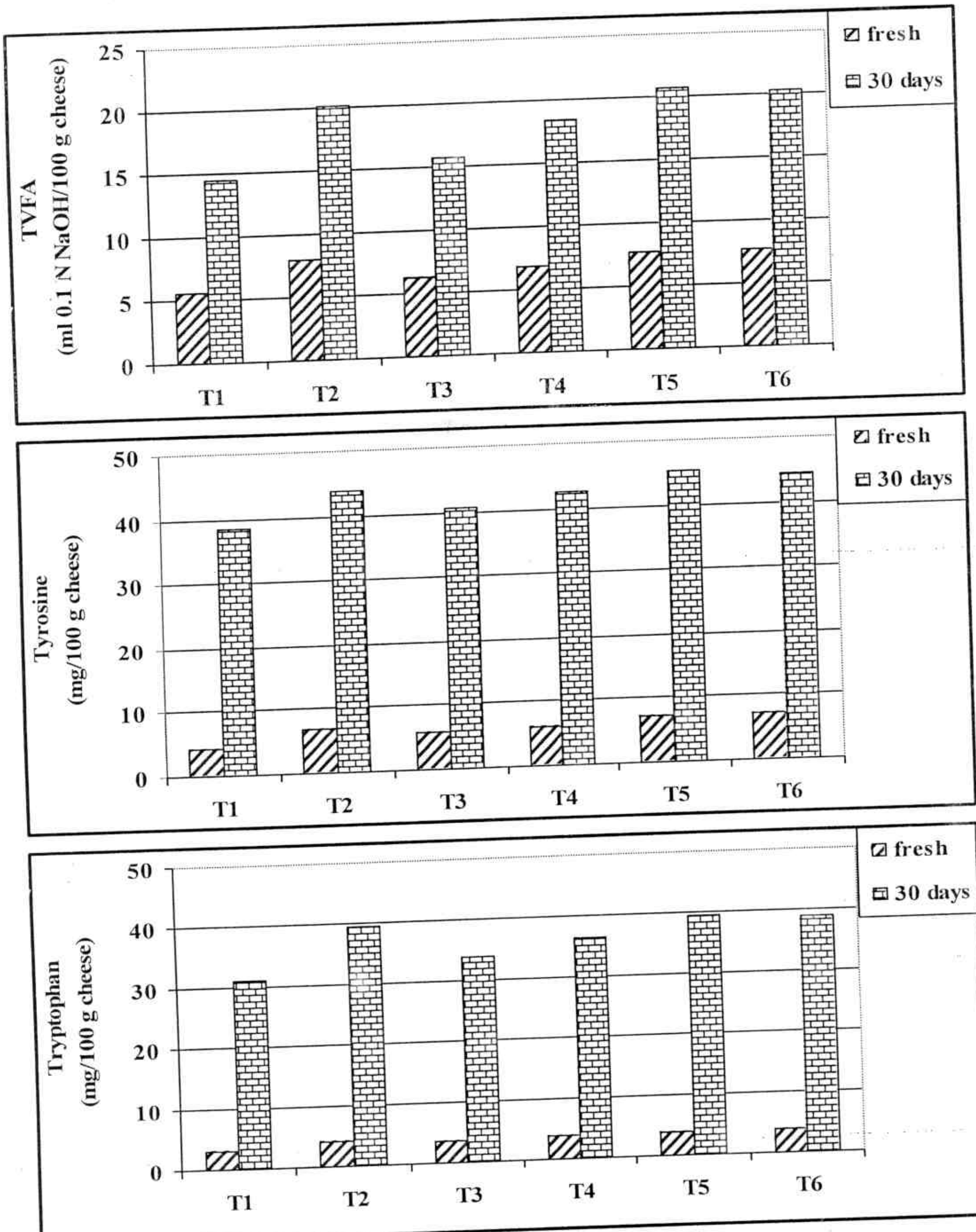
Statistical analysis illustrated that TA % and pH values in all Mozzarella cheese treatments were significantly affected by the treatment, interaction between treatment and storage period *(P < 0.0001)* with LSD 0.055 and 0.032 for TA % for treatment and storage period, respectively, and 0.068 and 0.039 for pH value in the same previous order.

Table (14) TVFA*, Tyrosine and Tryptophan of Mozzarella cheese from different treatments

Treatments		TVFA *	Tyrosine (mg/100g cheese)	Tryptophan (mg/100g cheese)
T1	Fresh	5.67	4.19	3.03
T2		8.03	6.97	4.03
T3		6.27	5.72	3.62
T4		6.83	6.19	3.78
T5		7.77	7.28	4.01
T6		7.67	7.18	3.90
T1	30 days	14.40	38.49	31.04
T2		20.03	43.85	39.53
T3		15.73	40.65	33.77
T4		18.35	42.47	36.33
T5		20.67	45.16	39.37
T6		20.18	44.51	38.80

* ml Na OH 0.1 N / 100 g cheese.

T1: Control standardized buffaloes' milk
T2: Control Cows' retentate
T3: Control Buffaloes' retentate
T4: Buffaloes' retentate stretched in 1% brine solution
T5: Buffaloes' retentate stretched in 2% brine solution
T6: Buffaloes' retentate stretched in 3% brine solution



T1: Control standardized buffaloes' milk
T2: Control Cows' retentate
T3: Control Buffaloes' retentate
T4: Buffaloes' retentate stretched in 1% brine solution
T5: Buffaloes' retentate stretched in 2% brine solution
T6: Buffaloes' retentate stretched in 3% brine solution

Fig (20) TVFA,Tyrosine and Tryptophan of different types of Mozzarella cheese.

11- Total Volatile Fatty Acids (TVFA):

From TVFA results, a wide differences could be observed among all treatments. In case of UF-Mozzarella cheese, it had higher content of TVFA than that in traditional one which may be due to the difference in the starter culture. **McBrearty *et al.* (2001)** reported that quantitative differences in volatile compounds were observed in the cheese harbouring *Bifidobacteria* most notably acitic acid. This confirmed our results. Also, they were higher in cows' UF-cheese than that of buffaloes' UF-cheese. The TVFA content of all cheeses increased during storage, this might be attributed to the growth of the starter culture. This agree with many workers **(Hassan and Abdel-Kader, 2000, Badawi *et al*, 2004).** The TVFA content of Mozzarella cheese when fresh and after storage recorded (5.67 & 14.40), (8.03 & 20.03), (6.27 & 15.73), (6.83 & 18.35), (7.77 & 20.67) and (7.67 & 20.18 %), for treatments T1 to T6, respectively.

Analysis of variance illustrates that, TVFA was affected by replication, treatment and storage period ***(P < 0.0001)*** with LSD 1.477 and 0.853, respectively.

12- Soluble tyrosine and tryptophan contents:

The changes in tyrosine and tryptophan of traditional, UF-cows' and buffaloes' Mozzarella cheese when fresh and after storage period are recorded in **Table (14).** It was obvious that soluble tyrosine and tryptophan contents were the lowest in traditional cheese (T1). This may be attributed to the difference in the starter cultures used and the addition of more starter which increased the protein hydrolysis and produced smaller molecules of amino acids. On the other hand, it is obvious that soluble tyrosine and tryptophan increased by stretching the curd in brine (T4, T5 and T6). The tyrosine and tryptophan contents were higher in cows' cheese than that of buffaloes' as it is known that cows' casein is more hydrolysed than buffaloes' casein. It is clear that, tyrosine and tryptophan contents increased in all treatments after one month of storage period at $\simeq$ 5 °C. These results are in line with those found by **Hassan and Abdel-Kader (2000)** and **Badawi *et al.* (2004).**

Concerning to tryptophan content from statistical point of view there was no significant differences between treatments T2 and T5; and T6 ***(P < 0.0001)*** with LSD 1.939 and 1.119 for tyrosine in treatment and storage period, respectively, and 2.777 and 1.603 for tryptophan in the same privous order.

III- Physical properties of Mozzarella cheese:

The differences in the physical and chemical properties between cows' and buffaloes' milk such as higher calcium, phosphorus and ash contents in buffaloes' milk than cows' milk; also the high concentration of salts in UF-retentate plays an important role in the hardness and quality of Mozzarella cheese **Amer *et al.* (1978).**

A- Meltability:

One of the main characteristics of Mozzarella cheese is the ability to melt smoothly and evenly when heated. Utilization of salt soluition as a stretching water improved the melting properties of the resultant cheeses. These results are due to the low calcium and phosphorus contents occurs through the mineral exchange between calcium and sodium in the curd during stretching.. This conclusion was in conformity with those reported by **Keller *et al.*, (1974), Lawrence *et al.* (1983 & 1984), Anis and Ladkani (1988), Kim and Yu (1988), Kiely *et al.* (1992) and Kindstedt (1993),** who reported that as curd calcium and phosphorus levels decreased, meltability by disc test increased.

Calcium reduction improves the melt and flow properties of Mozzarella cheese *i.e.*, the cheese was visibly softer **(Metzger *et al.* 2001 a).** Moreover, using *bifidobacteria* as an adjunct starter may contributed to ripening espicially in the formation of low molecular mass peptides as it can hydrolyse the denaturated whey proteins **(Gomes and Macate, 1998).** Also, using stretching brine increased the the moisture and decreased the salt content in the resultant cheeses (Table 12), which affect the activity of starter and increase proteolysis. This can explain the increase of T4, T5 and T6 in meltability than the controls (T1 and T3).

Meltability of cheese made from cows' retentate was higher than that of buffaloes' retentate. This confirmed by the results of **Ghosh and Singh, (1991)** and **El-Batawy *et al.*, (2004).**

It was clear that the meltability of traditional and UF-Mozzarella cheese grdually increased for both tube and disc methods by the end of storage period.

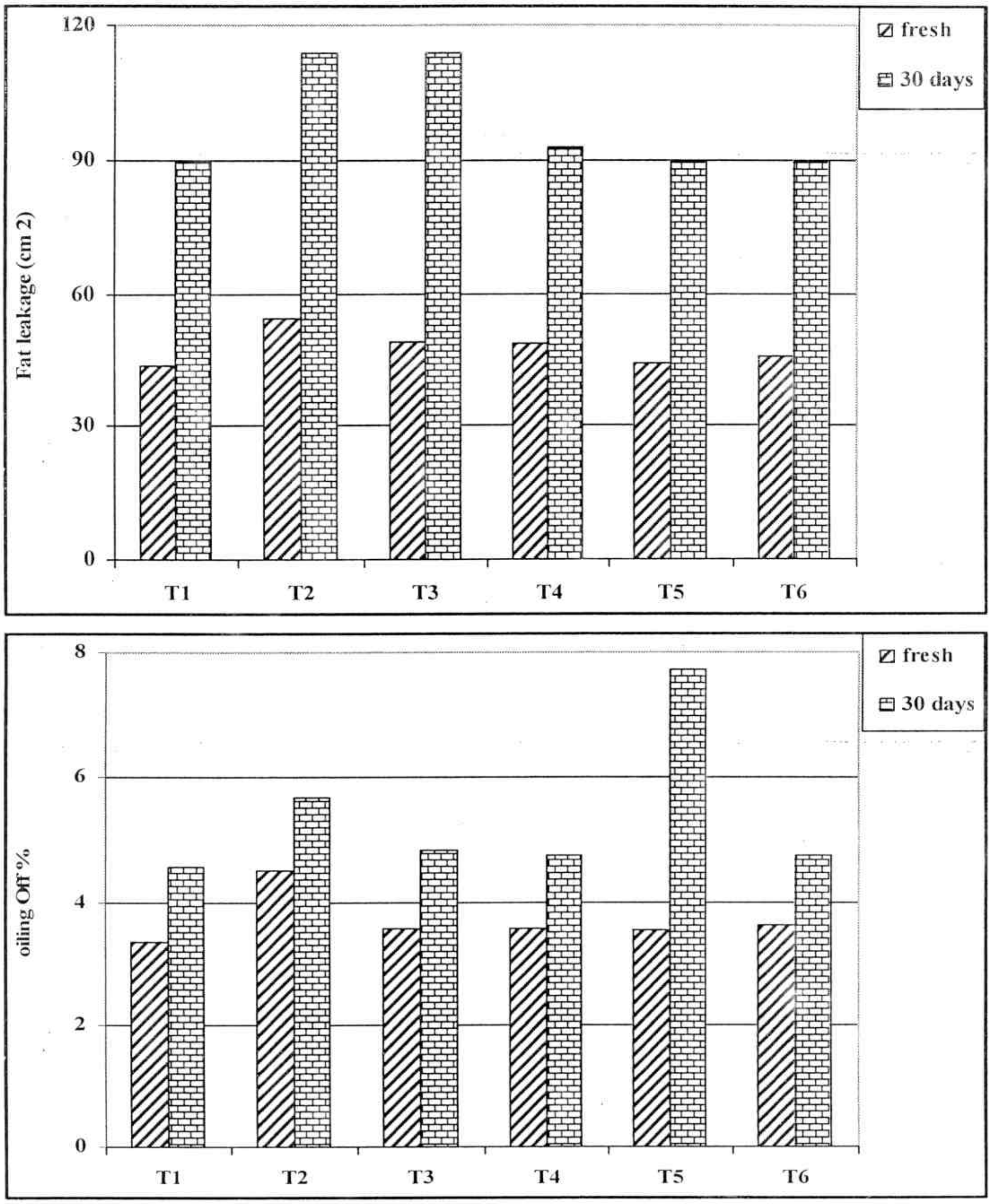
The increase in melting property of Mozzarella cheese during storage are thought to be due to breakdown of casein matrix by some proteolysis occurs in during storage which, can be explained in term of changes in moisture and protein states within the cheese stracuture, a dramatic increase in moisture holding capacity occurs during aging, concomitantly moisture migrates from the fat-serum channals into the protein matrix, thus the protein becoms more hydrated and results in an increase of meltability. These results are coincided with those reported by **Abd El- Rafee *et al.* (1998), Hong *et al.* (1998), McMahon *et al.* (1999), Roweny *et al.* (1999), Rudan *et al.* (1998) and Abd El-Hamid *et al.* (2001 b). Oberg *et al* (1992)** reported that meltability estimated by the tube test significantly increased during aging for 28 days at 4 °C. This is in line with our results.

Analysis of variance illustrate that meltability (both tube and disc methods) of all Mozzarella cheese treatments is affected by replication, treatment and the interaction between treatment and storage period ***(P < 0.0001)***, with LSD 3.148 and 1.818 for meltability (tube method) of treatment and storage period, respectively, and 7.263 and 4.193 for meltability of disc method in the same order.

B- Fat leakage and Oiling off:

Excessive fat leakage and oiling off considered to be a serious of defects that detracts from melted cheese appearance on pizza and related foods, hence excessive is a major quality problem for Mozzarella cheese makers. Data presented in **Table (15) and Fig (22)** indicated that Mozzarella cheese made from UF-cows' retentate, (treatment T2) showed the highest fat leakage level (54.42 & 114.01) and oiling off (4.51 & 5.68) in fresh and after one month of storage, respectively. These results could be ascribed to lower protein content in cows'; leading to high F/DM in cheese, and more fat available within the casein matrix, then more fat is released during melting **(Kindstedt *et al*, 1989, Kindstedt, 1993** and **Abd El-Gawad, 1998).** Also, **Dalgleish (1981)** reported that less casein is incorporated into the matrex, resulting in less fat entrapment. The fat in Mozzarella cheese exists as globules dispersed in the serum throughout the protein matrix and during melting it coalesces into pools that flow as the protein matrix collapses, consequently, high fat on a DM basis Mozzarella cheese melts more but produces more free oil **(McMahon *et al.*,1993).**

Fat leakage and oiling off was decreased in cheese stretched in brine and the lowest figures was for that stretched with 2 % brine.



T1: Control standardized buffaloes' milk
T2: Control Cows' retentate
T3: Control Buffaloes' retentate
T4: Buffaloes' retentate stretched in 1% brine solution
T5: Buffaloes' retentate stretched in 2% brine solution
T6: Buffaloes' retentate stretched in 3% brine solution

Fig(22) Fat leakage and oiling off of different types of Mozzarella cheese.

From the results it is obvious that fat leakage and oiling off for traditional and UF-Mozzarella cheeses increased after storage, this increase may be partly related to the increase in the meltability of Mozzarella cheese. This phenomenon could be attributed to the changes in the polymorphic structure of milk fat in Mozzarella cheese during storage, **(Rowney *et al.*, 1998 a & b).** Also, these results are in conformity with those demonstrated by **Kindstedt and Fox (1991), Yun *et al.* (1995 a), Renda *et al.* (1997), Abdel-Rafee *et al.* (1998 a), Hassan and Abdel-Kader (2000), Abdel–Hamid *et al.* (2001a)** and **El-Batawy *et al.* (2004).**

Analysis of variance indicated that there was high significant differences for fat leakage of all Mozzarella cheese treatments ***(P < 0.0001)*** with LSD 4.473 and 2.583 for treatment and storage period, respectively. Statistically oiling off results showed that there was a significant differences between cheese samples affected by treatments and storage period ***(P < 0.0001)***, with LSD 0.259 and 0.149 of treatment and storage period, respectively.

V- Texture Properties:

The texture plays an important role in the cheese quality and its changes is one of the major events occuring during ripening. The texture of cheese depends upon the status of composition and the extent of biochemical changes taken place during ripening.

The texture characteristics of Mozzarella cheese made from the standardized buffaloes' milk and Mozzarella cheese made from either cows' or buffaloes' retentates are presented in Table (16).

Hardness, Springiness and Cohesiveness:

Hardness is described to the panelist as the force required to penetrate the sample with the molar teeth (from soft to firm), **Lee *et al.* (1978).** From the obtained results it was noticed that the storage of cheese increased the hardness for all Mozzarella cheese treatments. Also, using of UF-retentate caused high increase in the hardness and ultimate hardness of the curd which influenced curd structure **(Dalgleish, 1981).** Hardness of cheese increased in treatments with increasing protein concentration in cheese.

Moisture decrease resulted in a firmer texture due to alteractions in the casein matrix **(Tunick *et al.*, 1991).** Also, the lower the moisture content in cheese, the lower the levels of proteolysis, the coarser and the stronger protein network, and also the reduced ability of fat and protein phase to move in relation to each other that tend to increase cheese hardness.

The average hardness of fresh Mozzarella cheese was (8.24, 4.75, 9.01, 7.91, 7.37 and 7.20) for treatment T1 to T6, consecutively. After one month of storage the hardness of cheese recorded (9.59, 5.13, 13.44, 10.36, 9.84 and 9.42) in sequence.

The variation in the hardness of different Mozzarella cheese treatments was due to the diffences in the chemical composition of these cheeses. The results clear that UF-cows' cheese recorded the lowest value of hardness as it had the highest moisture and lowest protein content (Tables 12& 13). Also, UF-buffaloes' cheese was firmer than traditional cheese as it was lower in moisture and higher in protein content. Stretching the curd in brine lowred the calcium content and increased the moisture in the resultant cheese (Tables 12 and 13), thus the hardness was decreased. The results are in accordance with **El-Batawy *et al.* (2004)** as they stated that storage of Mozzarella cheese in refrigirator for 4 weeks increased the hardness due to decrease in moisture content, but prolonging the storage period (than 4 weeks) may reduce the hardness due to the breakdown of the protein net work during proteolysis.

Analysis of variance indicated that there was high significant differences for hardness of all Mozzarella cheese treatments ***($P < 0.0001$)*** with LSD 0.642 and 0.371 for treatment and storage period, respectively.

Springiness described to the panelists as bouncing property of the sample through several consicutive bites (from plastic to elastic).

The obtained values of this property of the Mozzarella cheese treatments when fresh ranged from 10.50 to 13 mm while it was ranged from 10.75 to 14.75 mm after 30 days of storage. This can be attributed to the differences in the chemical composition in addition to different treatments done during making these cheeses.

Springiness took the same trend of hardness as it was higher in buffaloes' cheese than cows' cheese. Also, it was reduced by stretching the curd in brine. Concerning to analysis of variance it indicated that there was significant differences of all Mozzarella cheese treatments ***(P < 0.0001)*** with LSD 0.733 and 0.423 for treatment and storage period, respectively. The results are in the vicinity of those given by **El-Batawy *et al.* (2004)**.

Cohesiveness known as the degree to which the cheese samples deforms before rupturing, therefore, cohesiveness value is a direct function of the work needed to overcome the internal bonds of the material. The presented data in **Table (16)** indicate the cohesiveness values of different Mozzarella cheese treatments which, ranged from 0.426 to 0.550 cm and after 30 days it was 0.430 to 0.580 cm. These variations consider to be a narrow range which mean that this property of the produced Mozzarella cheeses is not greatly affected by different treatments during the manufacture. However, there was a slight increase in cohesiveness during storage.

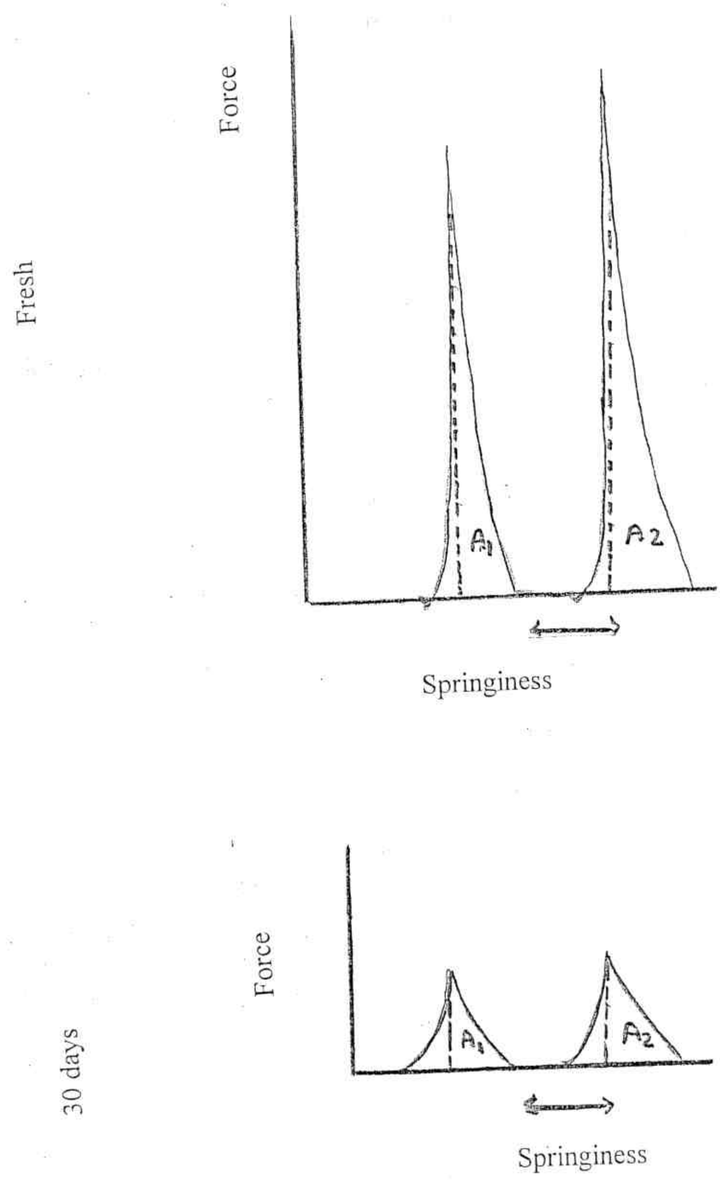
There was non-significant differences for cohesiveness of all Mozzarella cheese treatments ***(P < 0.0001)*** with LSD 0.021 and 0.012 for treatment and storage period, respectively. The results are in line with **El-Batawy *et al.* (2004).**

Table (16) Texture properties of Improved Mozzarella cheese from different treatments.

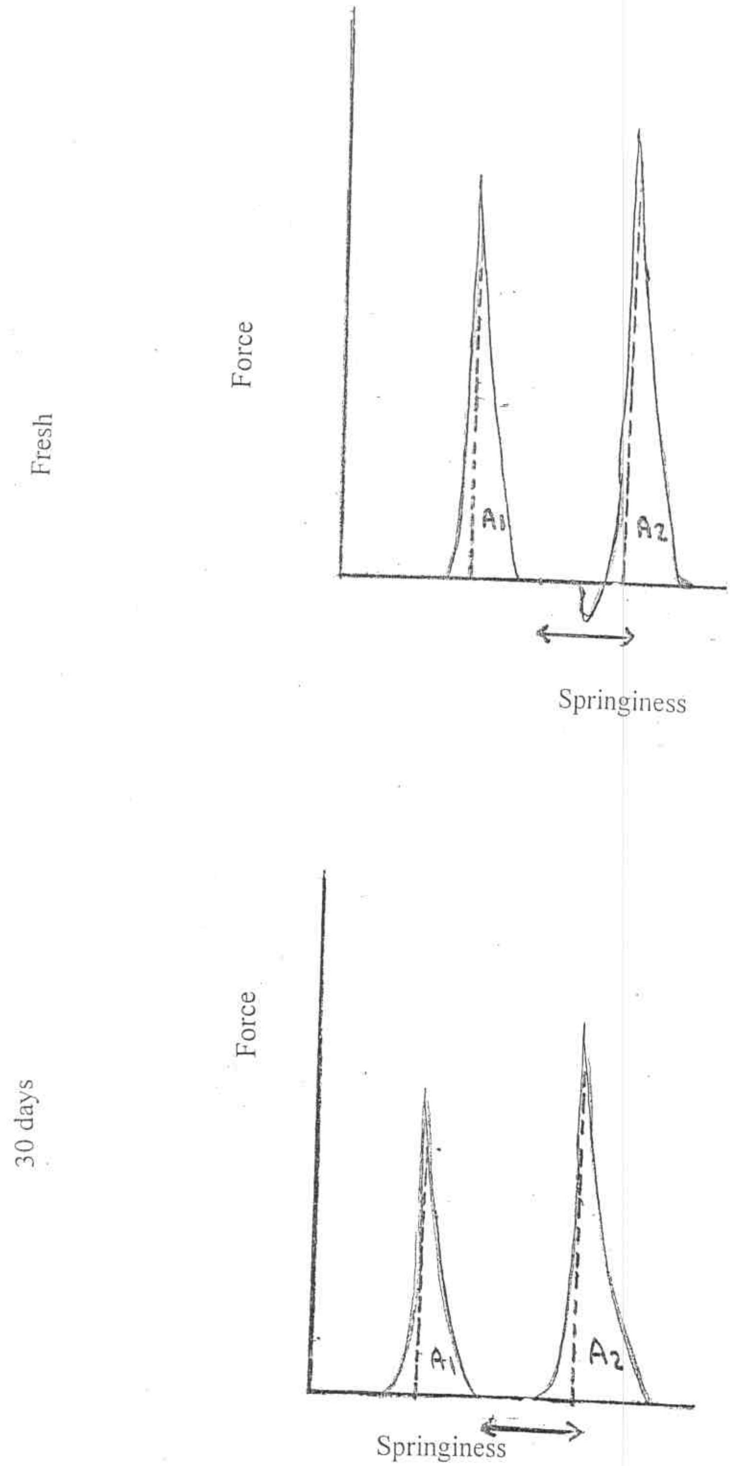
Treatments		Hardness (N)	Springiness (mm)	Cohesiveness (cm)	Gumminess (N)	Chewiness (n-mm)
T1	Fresh	8.24	13.0	0.438	3.61	46.92
T2		4.75	10.50	0.550	2.61	27.49
T3		9.01	12.75	0.464	4.17	53.13
T4		7.91	12.0	0.442	3.45	41.47
T5		7.37	11.5	0.437	3.22	37.03
T6		7.20	11.5	0.426	3.07	35.33
T1	30 days	9.59	14.75	0.458	4.39	64.74
T2		5.13	11.75	0.580	2.98	34.72
T3		13.44	13.25	0.496	6.67	88.30
T4		10.36	12.5	0.452	4.69	58.82
T5		9.84	11.25	0.443	4.36	49.09
T6		9.42	10.75	0.430	4.05	43.59

N: Newton mm: millimeter n-mm: Newton - millimeter

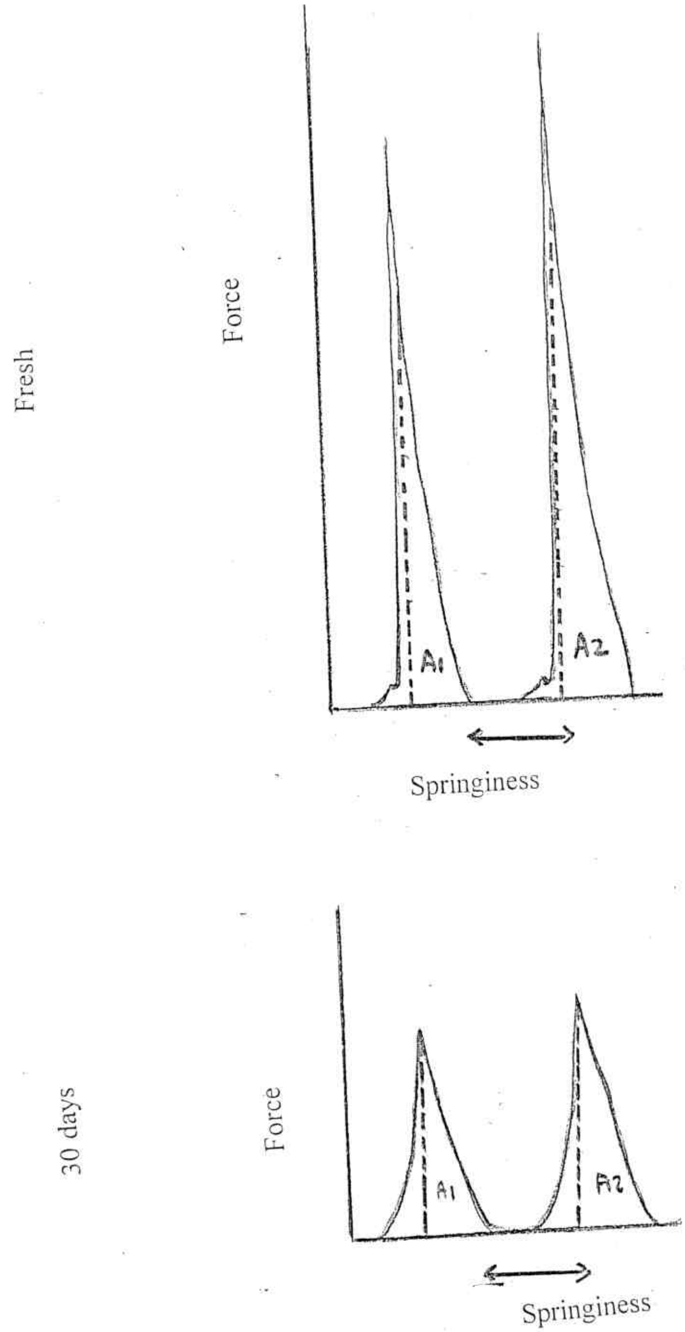
T1: Control standardized buffaloes' milk
T2: Control Cows' retentate
T3: Control Buffaloes' retentate
T4: Buffaloes' retentate stretched in 1% brine solution
T5: Buffaloes' retentate stretched in 2% brine solution
T6: Buffaloes' retentate stretched in 3% brine solution



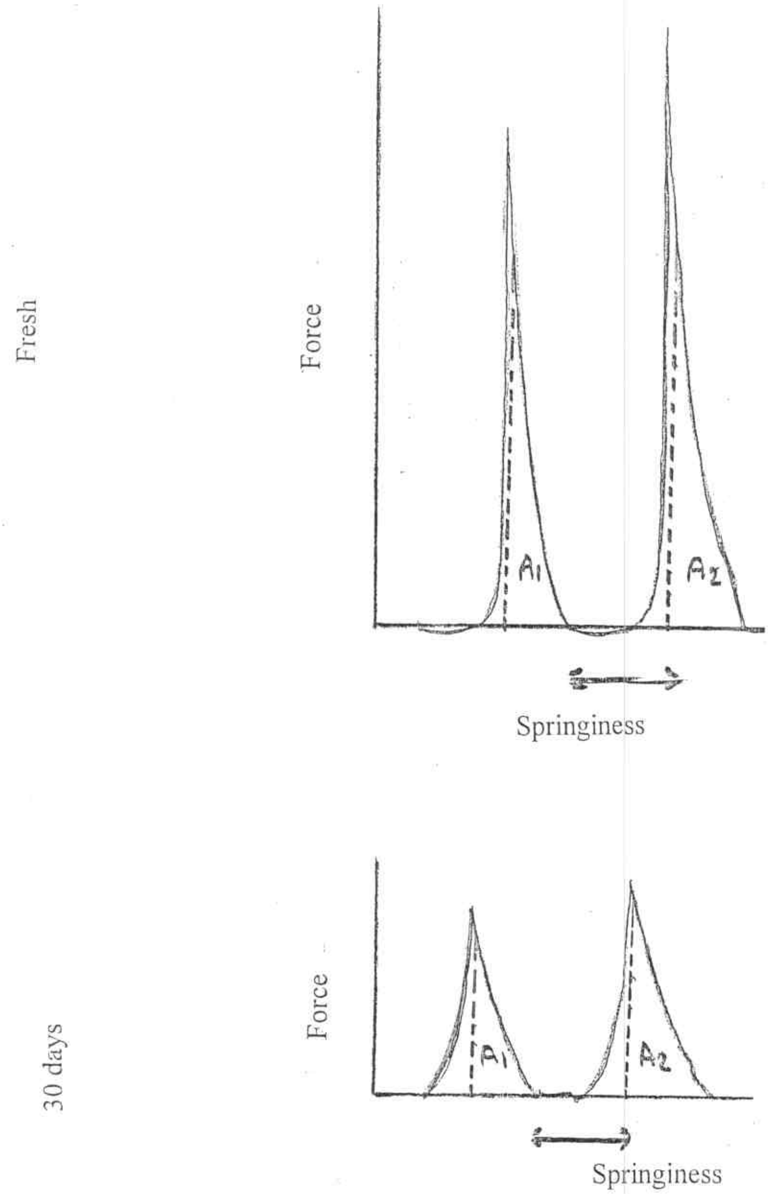
Texture Properties of Different Types of Mozzarella Cheese



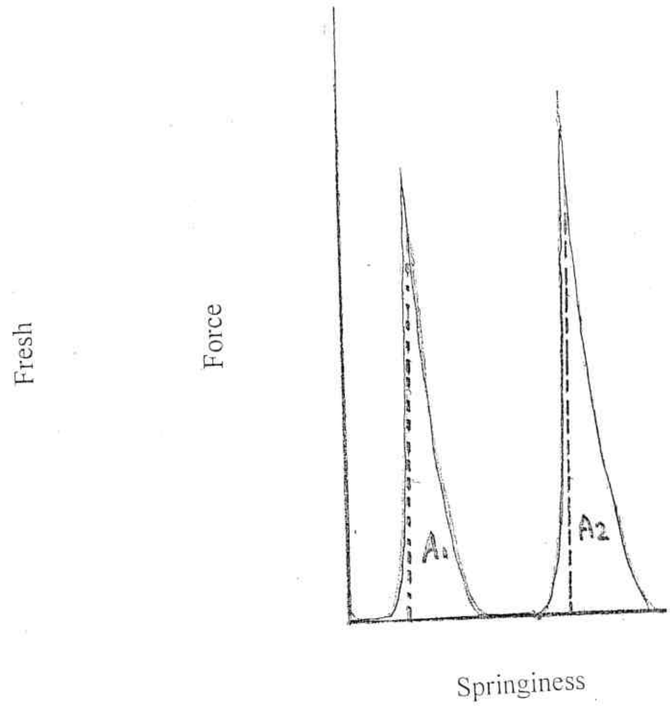
Texture Properties of Different Types of Mozzarella Cheese

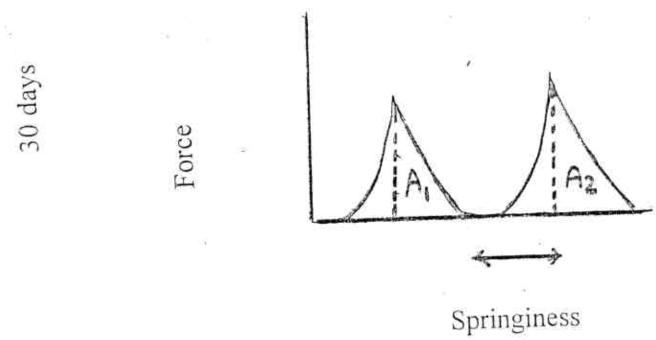


Texture Properties of Different Types of Mozzarella Cheese

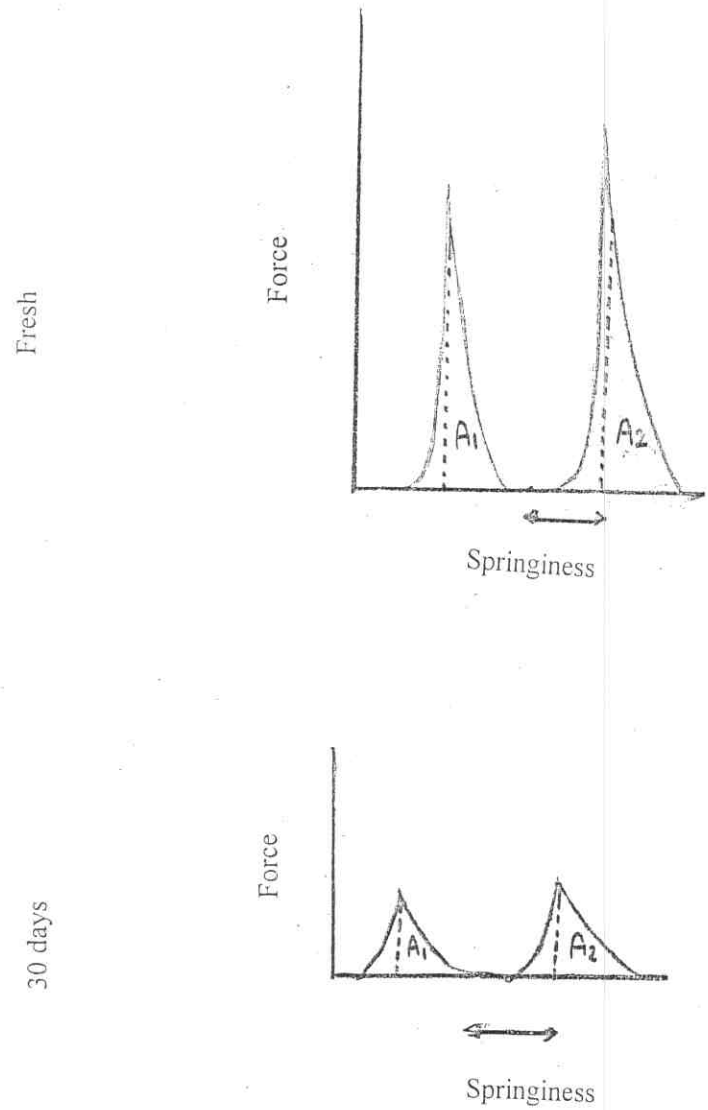


Texture Properties of Different Types of Mozzarella Cheese





Texture Properties of Different Types of Mozzarella Cheese



Texture Properties of Different Types of Mozzarella Cheese

Gumminess and Chewiness:

Gumminess is expressed as the product of hardness and cohesiveness. It can be seen from **Table (16)** that the average of Gumminess of Mozzarella cheese was 3.61, 2.61, 4.17, 3.45, 3.22 and 3.07 N for fresh samples for treatment T1 to T6, respectively, while, it was 4.39, 2.98, 6.67, 4.69, 4.36 and 4.05 N after one month of storage in sequence. Mozzarella cheese made from standardized buffaloes' retentate (T3) showed the highest values of Gumminess treatment followed by the traditional one treatment (T1). Stretching the curd in brine decreased the gumminess. The lowest value was for that made from cows' retentate treatment (T2). The results are in line with those given by **El-Batawy *et al* (2004).**

Chewiness discribed to be the number of chews required to swallow a certain amount of sample (from tender to tough). Also, it can be measured by the time required to masticate the cheese sample at a constant rate of force application to reduce it to a consistencey suitable for swallowing. This property expressed mathematically from the instron as the product of Gumminess & Springiness. The average chewiness was 46.92, 27.49, 53.13, 41.47, 37.03 and 35.33 n-mm for treatment T1 to T6, consecutivly.

Statiatical analysis indicates that there was high significant differences for gumminess of all Mozzarella cheese treatments ***(P < 0.0001)*** with LSD 0.353 and 0.204 for treatment and storage period, respectively.

On the other hand, there was high significant differences in chewiness of all Mozzarella cheese treatments ***($P < 0.0001$)*** with LSD 0.362 and 2.519 for treatment and storage period, respectively.

In a conclusion, using of salt solution as a stretching water decrased Ca, P/DM contents of Mozzarella cheese and this afects the texture properties of the produced cheese due to that calcium plays an integral role in cheese texture by cross-linking protein. As a result, the amount of calcium in cheese has an effect on texture if the total calcium content of cheese is reduced, then the amount of cross-linking between casein polymers is reduced, subsequently the cheese becomes softer. **Keller *et al.*, (1974), Lowrence *et al.*, (1983), Lucey and Fox (1993), Solorza and Bell (1995), Yun *et al.*, (1995 a), Cheng *et al.*, (1997)** and **Metzger *et al.*, (2000, 2001 a & 2001 b)** stated that, calcium and phosphate promote cheese regidity as they are responsible for cross-linkages formation within the casein network. Accordingly, cheese with a high mineral content will have a more completely cross-linked structure and be more riged, and this improved its meltability.

IV- Chemical composition of Mozzarella cheese whey:

A reduction in the amount of total whey including drained whey and that whey from press in case was noted when higher solids milks were used during cheese making. The total whey was 86.51 % of mass derived from cheese milk in case of cheese making from control milks, but this value was reduced to about 84.08 % for UF-cheeses.

Tabulated data in **Table (17)** illustrate the whey composition and pH values of different Mozzarella cheese treatments. **Total solids** content of whey from UF-cheeses contained more total solids than whey from control cheese, from milk as it was 6.25 versus 5.74 % in treatments T3 and T1, respectively, these data agree with **Fernandez and Kosikowski (1986 a & b)** and **Lucey *et al.* (2005).** Also the total solids results of whey from UF-buffaloes' cheese was higher than that from UF-cows' cheese which was similar with those obtained by **Abd El-Gawad (1998).**

Increased component concentration in whey from UF-retentate cheese was previously reported for Cheddar **(Green, *et al.*, 1981),** Colby and Brick cheeses **(Bush *et al.*, 1983)** and Ras cheese **(Hefney *et al.*, 2004).** Although whey contained more of the total solids, more retentate cheese also was obtained.

Fat content in whey from UF-cheeses was higher than that of whey from traditional control cheese (T1) as it was 0.4 and 0.3 % in sequence. This is attributed to several factors, it is probably due to the excessive recirculation needed in the UF-system used, which could have damage some fat globules **Lucey *et al.* (2005).** Also, concentrated UF-retentates have relatively less of their casein molecules directly involued in curd formation. Therefore, less casein is incorporated into the curd matrix, resulting in less fat entrapment **(Dalgleish, 1981). Green *et al.* (1981)** observed a reduction in the degree of aggregation of the casein micelles proportional to retentate. **Bush *et al.* (1983)** stated that the high fat losses observed from retentates may result from difficulties encountered in stirring concentrated retentates, leading to curd abrasion and subsequent release of fat globules.

Looking at **total protein**, the whey obtained from the UF-retentate was higher in total protein content than that obtained from control milk (0.67 and 0.49 %, respectively). This may be due to the abrasion occurs in the UF-curd which explained, breviously. Also, total protein was higher in buffaloe's UF-cheese whey than that of cow's UF-cheese whey.

The ash content in the whey of all treatments took the same trend of total protein as well as calcium and phosphorus contents.

Lactose levels was higher in the whey derived from UF-retentates than whey from control milk which may be due to the higher glycolysis in the former which, metabolized more lactose (its starter contains ***Bifidobacteria***).

All the results belong to the whey composition were in accordance with those reported by **Fernandez and Kosikowski (1986 a & b & c), Abd El-Gawad (1998), Hefney *et al.* (2004) and Lucey *et al.* (2005).**

The acidity and pH values were 0.33 % & 4.54, 0.30 % & 4.60 and 0.29 % & 4.65 for traditional,UF-cows' and UF-buffaloes' treatments, respectively. The higher acidity and low pH of whey drained from making traditional Mozzarella cheese may be attributed to the higher lactose content in the standardized buffaloes' milk. The results of whey drained from UF-cheese treatments are in agreement with the observation of **Rao and Renner (1988).**

Table (17) Chemical composition, and pH values of different Mozzarella cheese whey

Constituents	T1	T2	T3	T4	T5	T6
Total solids %	5.74	6.15	6.25	6.25	6.25	6.25
Fat %	0.3	0.4	0.4	0.4	0.4	0.4
Ash %	0.55	0.63	0.72	0.72	0.72	0.72
Total protein %	0.49	0.55	0.67	0.67	0.67	0.67
Calcium %	0.049	0.052	0.056	0.056	0.056	0.056
Phosphorus %	0.036	0.041	0.045	0.045	0.045	0.045
Titratable acidity %	0.33	0.30	0.29	0.29	0.29	0.29
pH value	4.54	4.60	4.65	4.65	4.65	4.65

T1: Control standardized buffaloes' milk
T2: Control Cows' retentate
T3: Control Buffaloes' retentate
T4: Buffaloes' retentate stretched in 1% brine solution
T5: Buffaloes' retentate stretched in 2% brine solution
T6: Buffaloes' retentate stretched in 3% brine solution

V- Chemical composition of Mozzarella cheese stretching water:

Data in **Table (18)** show the chemical composition of Mozzarella cheese stretching water.

Stretching water of T4, T5, and T6 treatments have a higher **total solids** content than that of the other treatments. This may be attributed to increase of ash content in these treatments. The average of total solids content stretching water was 4.29, 4.44, 4.44, 5.32, 6.34 and 7.45 for treatments T1 to T6, respectively.

With regard to **fat content** the average in stretching water was 0.3, 0.4, 0.4, 0.4, 0.3 and 0.3 % for treatments T1 to T6 in sequence. It was reported that stretching and molding the curd in hot water caused higher fat losses than in hot brine, thus the fat content in treatments T5 and T6 had lower content than T3. The same observation was recorded by **Fernandez and Kosikowski (1986).**

On the other hand, stretching water of UF-Mozzarella cheese treatments had a higher **protein content** than that of the traditional Mozzarella cheese. The average of TP of stretching water was 0.089, 0.102, 0.115, 0.115, 0.108 and 0.106 for T1 to T6 Mozzarella cheese treatments. As it is seen, there is no obvious trend for differences in various treatments. These results are in accordance with **Fernandez and Kosikowski (1986)** who reported that total protein lost to hot brine was not significantly different from that lost to hot water.

Stretching water of T4, T5 and T6 treatments have a higher **ash content** than that of the other treatments. This is expected due to the increase of calcium and phosphorus contents in these treatments, and also due to using brine solution as a stretching water. The average of ash content in stretching water was 3.76, 3.87, 3.88, 4.76, 5.81 and 6.89 % from T1 to T6 treatments, respectively.

Stretching Mozzarella cheese curd in the brine (treatments T4, T5 and T6) had a higher **calcium and phosphorus** contents than that of the other treatments. The calcium and phosphorus contents of stretching water from traditional Mozzarella cheese were 0.097 and 0.073 %, respectively. While, they were 0.099 & 0.077, 0.108 & 0.080, 0.123 & 0.092, 0.131 & 0.098 and 0.139 & 0.108 % for treatments T2 to T6, in the same order.

The acidity and pH values of stretching water of traditional Mozzarella cheese were 0.12 % and 5.32, respectively. While, they were 0.14 & 5.19, 0.14 & 5.17, 0.13 & 5.21, 0.12 & 5.29 and 0.13 % & 5.26 for treatments T2 to T6 in the same order. The chemical composition results of stretching water almost took the same trends of those given by **Fernandez and Kosikowski (1986), Abd El-Gawad (1998).**

Table (18)Chemical composition, and pH values of different Mozzarella cheese Stretching water.

Constituents	T1	T2	T3	T4	T5	T6
Total solids %	4.29	4.44	4.44	5.32	6.34	7.45
Fat %	0.30	0.40	0.40	0.40	0.30	0.30
Ash %	3.76	3.87	3.88	4.76	5.81	6.89
Total protein %	0.089	0.102	0.115	0.102	0.108	0.115
Calcium %	0.097	0.099	0.108	0.123	0.131	0.139
Phosphorus %	0.073	0.077	0.080	0.092	0.098	0.108
Titratable acidity %	0.12	0.14	0.14	0.13	0.12	0.13
pH value	5.32	5.19	5.17	5.21	5.29	5.26

T1: Control standardized buffaloes' milk
T2: Control Cows' retentate
T3: Control Buffaloes' retentate
T4: Buffaloes' retentate stretched in 1% brine solution
T5: Buffaloes' retentate stretched in 2% brine solution
T6: Buffaloes' retentate stretched in 3% brine solution

VI- Cheese yield:

Table (19) shows the yield of fresh Mozzarella cheese treatments, and percentage of increase compared with the traditional Mozzarella cheese. This yield was 13.49 kg/100 kg milk, 13.58, 15.72, 15.90, 16.01 and 16.06 % for T1 to T6 treatments, respectively. This accounts an increase of 0.7, 16.52, 17.81, 18.65 and 19.0 % T1 to T6 in order, than the traditional cheese. This increase is due to the greatest transfer rate of total solids, total protein and fat content beside the higher moisture in T4, T5 and T6 treatments.

Furthermore, the yield of Mozzarella cheese made from buffaloes' retentate was higher than that made from cows' retentate. These results are in agreement with those reported by **Kosikowski (1982), Bonassi *et al.* (1982), Ghosh (1987) and Abd El-Gawad (1998).**

Table (19) Yields and Increase rate of yield for different Mozzarella cheese treatments

Treatments	Yield %	Increase rate of yield %
Control standardized buffaloes' milk	13.49	---
UF- cows' retentate	13.58	0.70
UF-buffaloes' retentate	15.72	16.52
UF-buffaloes' retentate stretched in 1 % brine solution	15.90	17.81
UF-buffaloes' retentate stretched in 2 % brine solution	16.01	18.65
UF-buffaloes' retentate stretched in 3 % brine solution	16.06	19.00

VII- Organoleptic properties:

Sensory properties of Mozzarella cheese samples were examined when fresh and after storage period up to 30 days **(Table 20). The flavour** score of standardized buffaloes' traditional Mozzarella cheese recorded the lowest scores (40.0 when fresh and 43.0 after storage). Moreover, the flavour of cows' UF-cheese gained higher scores than buffaloes' UF cheese. This agree with **El-Batawy *et al.* (2004).** On the other hand, flavour score ranged from 41.0 to 45.0 and from 44.0 to 47.0 when fresh and after the storage for UF-buffaloe's Mozzarella cheese treatments.

These results may be due to the starter culture used as it is appeared therefore that, modified starter (yoghurt starter + *Bifidobacteria Bb–12* culture) used in UF- treatments T2, T3, T4, T5 and T6 gave higher scores of flavour.

These results are in accordance with **McBrearty *et al.* (2001)** who stated that during early ripening (even during manufacture) more extensive proteolysis and improved flavour were observed in the *Bifidobacteria* cheese compared with control cheese. They added that quantitative differences in volatile compounds were observed in the cheeses harbouring bifidobacteria, most notably acetic acid.

With regard to **body and texture** of Mozzarella cheese tended to be improved with increasing the storage period. It recorded 32.0 to 32.7 when fresh and after 30 days of storage for traditional Mozzarella cheese. Mozzarella cheese made from UF–cows' (T2) got higher scores than UF-buffaloes' cheese (T3) either when fresh or after storage. This may be due to that cows' casein is higher in breakdown than that of buffaloes. These results were in accordance with **El-Batawy *et al.* (2004)**; and this confirmed the results of part I in this study. It was obvious that using brine during stretching of cheese improved the body and texture of the cheese (T4, T5 and T6) as it removes some calcium and phosphorus, increased the moisture and decreased the salt content which activate proteolysis of the starter activity espicially in T4, T5 and T6 which contain *Bifidobacteria* as an adjunct starter. This cause more proteolysis and improve the body and texture of the cheese. Also, it enhanced the cheese stretchability, and meltability.

Analysis of variance illustrates that body and texture were significantly, affected by treatment and storage period, ***(P < 0.0001)*** with LSD 0.924 and 0.534 of treatment and storage period, respectively.

The appearance score of the cheeses slightly decreased after the storage period at $\simeq$ 5 °C. This may be due to a slight loss of water and shrinkage of the cheese, these results are in line with the findings of **El-Batawy *et al.* (2004).**

Analysis of variance illustrates that appearance of Mozzarella cheese was non significant, ***(P < 0.0001)*** affected by treatment, *(P < 0.0001)* with LSD 0.801 and 0.462 of treatment and storage period, respectively.

Table (20) Sensory evaluation scores of different Mozzarella cheese treatments.

Treatments		Flavour (50)	Body & Texture (35)	Appearance (15)	Total (100)
T1	Fresh	40.00	32.00	14.5	86.5
T2		44.00	33.00	15.0	92.0
T3		41.00	31.00	14.0	86.0
T4		42.00	32.00	14.5	88.5
T5		45.00	33.00	15.0	93.0
T6		42.00	32.00	14.5	88.5
T1	30 days	43.00	32.70	14.0	89.7
T2		47.00	33.30	14.5	94.8
T3		44.00	32.00	13.5	89.5
T4		44.00	33.00	14.0	91.0
T5		47.00	34.70	14.5	96.2
T6		45.00	34.00	14.0	93.0

T1: Control standardized buffaloes' milk
T2: Control Cows' retentate
T3: Control Buffaloes' retentate
T4: Buffaloes' retentate stretched in 1% brine solution
T5: Buffaloes' retentate stretched in 2% brine solution
T6: Buffaloes' retentate stretched in 3% brine solution

The total score ranged from 86.5 to 89.7 for traditional Mozzarella cheese when fresh and after 30 days of storage. They ranged from 86.0 to 93.0 and from 89.5 to 96.2 when fresh and after storage, respectively for other Mozzarella cheese treatments. The best cheese was T5 which stretched in 2 % brine as it gained 93.0 and 94.8 in fresh and ripened respectively.

Analysis of variance illustrates that total score of Mozzarella cheese was significantly, ***(P < 0.0001)*** affected by treatment and storage period with LSD 2.444 and 1.411 of treatment and storage period, respectively.