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Impact of Selenium on Functional Properties of White Soft Cheese

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ABSTRACT

White soft cheese was made from buffalo's milk. Selenium (Se) was added at cheese milk at the rate of 0.5, 0.8, and 1.0 ppm treatments. Resultant cheese was pickled in whey at 6±2C° up to 60 days, during which cheese samples were analyzed chemically for moisture, fat, titratable acidity, salt, soluble nitrogen, total nitrogen, total volatile free fatty acids, tyrosine, and tryptophan. The organoleptic properties of cheese were examined at fresh, 15, 30, 45 and 60 days of pickling.Obtained results showed that total solids (TS), total nitrogen (TN), salt, and fat were slightly increased with increasing the ratio of (Se) during the cold storage for 60 days. The control cheese had the highest both the firmness and syneresis value than the Se-enriched cheese. While the yield ratio of control sample was the lowest value of the treated cheese. Data also obviously that *Lactobacilli* and *Streptococci* count increased with increasing the levels of (Se), while the yeasts & molds were not detected in fresh cheese or after two weeks of storage, but they were detected and increased gradually with the progress of storage at 30 days up till 45 days.

Keywords: white soft cheese, trace elements, sodium selenite (Na_2SeO_3).

INTRODUCTION

Essential trace elements play an important role as a cofactor for certain enzymes involved in metabolism and cell, growth, most of them involved in the metabolism of proteins, carbohydrates, lipids, and energy. They are also necessary for the growth humans, development, muscle and nerve function, normal cellular functioning, and synthesis of some hormones and connective tissue. The role of trace elements in biological processing may provide avital clue for understanding the etiology of some diseases such as cancer. The ability of trace elements to function as substantial affecters in a variety of the processes necessary for life, such as regulating homeostasis and prevention of free radical damage, can provide an answer to the definite correlation between the content of trace elements and many common diseases. In the past ten years, studies have focused extensively on determing the levels of trace elements in cancers patients, in an attempt to understand the nature of relationships between cancer and trace elements. Thus, the expected role of trace elements will enable us to understanding of the etiopathogenesis of cancer and provide a rapid diagnostic facility and also create effective treatment modalities (Al-Fartusie and Mohssan, 2017).

Furthermore, Mineral elements occur in milk and dairy products as inorganic ions and salts, as well as parts of organic molecules, such as proteins, fats, carbohydrates, and nucleic acids (Zamberlin *et al*., 2012). On the other hand, the antioxidant capacity of milk and milk products is mainly due to sulfur-containing amino acids, such as cysteine, phosphate, vitamins A, E, carotenoids, zinc, selenium, enzyme systems, superoxide dismutase, catalase, glutathione peroxidase, milk oligosaccharides and peptides that are produced during fermentation and cheese ripening (Khan *et al*., 2019).

Pophaly *et al.* (2014) revealed that Se is an essential trace element for all higher eukaryotes as well as for some prokaryotes, and was initially regarded as a toxic element and a carcinogen (Oldfield, 2006). But, later its nutritional importance was recognized with the emergence of evidence supporting its involvement in diverse physiological reactions establishing its status as an essential dietary supplement. The nutritive value of Se depends largely on the concentration and type of Se species present or supplemented with food (Kieliszek and Blazejak, 2013).

Mineral and vitamin-enriched milk products are the most important fortified dairy products, as mineral and vitamin deficiencies are serious public health problems in many developing countries and often even occur in industrialized countries. Common mineral and trace element deficiencies involve iron, zinc, Se, iodine, and calcium. The most important vitamin deficiencies today are probably those of vitamin A, vitamin D, and folic acid (Saxelin *et al*., 2003).

The aim of this work was to find out whether some Se -fortified milk products could be obtained without the use of animal feed additives to compensate for the low Se in natural milk and without affecting the different properties of these products or bacterial strains used, and to improve the daily Se requirements of the consumer.

The selection of strains should be carefully evaluated to increase probiotic cell viability during cheese manufacture, as well as to limit potential changes in the sensory properties of cheese, especially in pickled type cheeses like Domiati cheese in Egypt (Yerlikaya and Ozer, 2014). Also using probiotic bacteria in the making of cheese, especially lactobacilli, can lead to many changes in the sensory properties, such as hydrolysis of peptides into oligo-peptides and amino acids that affect the flavor, texture, and texture of the cheese (Souza and Saad, 2009).

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This work investigation carred to study the effect of adding selenium to milk before to thermal treatment on the characteristics of Tallaga cheese prepared there.

MATERIALS AND METHODS

Materials:

Good quality whole fresh buffaloes milk (morning milkings) was obtained from the experimental farm, Faculty of Agriculture, Al-Azhar University.

Starters were used in our experiments: *Lactococcus lactis subsp. lactis* (*Lac. lactis*), *Lactococcus lactis subsp. cremoris* (*Lac. cremoris*) *and Lactobacillus casei* (*Lb. casei*) were obtained from Dairy Department, Faculty of Agriculture, Assiut University.

Sodium Selenite (Na_2OSe_3, M. W. 172.95, Purity 99.5%) was purchased from Electro Scient Chemical Company, Kasr El-Eeny, Cairo.

Methods:

Manufacture of white soft cheese:

White soft cheese (W.S.C) was made by a conventional used method of making Domiati cheese according to the adopted method of Mohammed Mohammed *et al.* (2016), with some modification as follow :

Homogenized standardized morning buffalo's milk (6% fat) was divided into four equal portions every part was heat treatment to 72±1◦C /15 sec. rapidly cooled to 40-42◦C, then 2% of active strain culture were added then wait 30 min, after that 0.02% calcium chloride; 4% sodium chloride and 0.003% microbial rennet solution were added sequentially, the four portions are as follows:

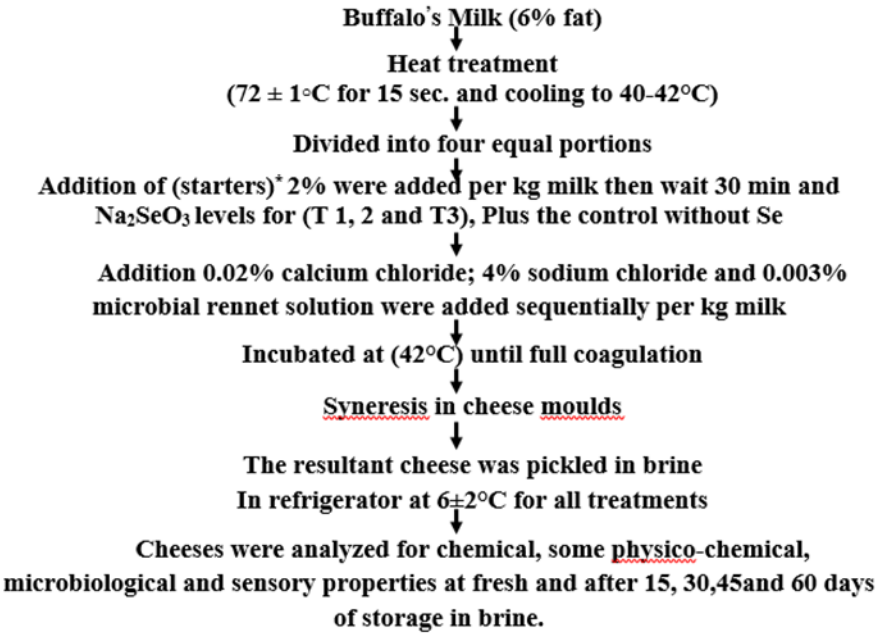
C: Control cheese was made using active strain culture (*Lac. lactis subsp. Lactis; Lac. lactis subsp. cremoris* and *Lb. casei*) at the rate of (1:1:1) respectively, were without selenium and storage at arefrigerator at 6±2°C.

T_1: Adding 2% (w/w) active strain culture (*Lac. lactis subsp. lactis; Lac. lactis subsp. cremoris* and *Lb. casei*) in the rate of (1:1:1) respectively, supported by 0.5 ppm Na_2SeO_3.

T_2: Adding 2% (w/w) active strain culture (*Lac. lactis subsp. lactis; Lac. lactis subsp. cremoris* and *Lb. casei*) in the rate of (1:1:1) respectively, supported by 0.8 ppm Na_2SeO_3.

T_3: Adding 2% (w/w) active strain culture *Lac. lactis subsp. lactis; Lac. lactis subsp. cremoris* and *Lb. casei*) in the rate of (1:1:1) respectively, supported by 1 ppm Na_2SeO_3.

About 350 g of resultant cheeses were packed in a1000 g capacity of plastic cans. The cans were filled with their own drained whey; the samples were stored in a refrigerator at 6±2°C for all treatments. All samples were taken when Controlled (fresh) and after storage for 15, 30, 45, and 60 days for analysis.



* Active strain culture: (mixed 1:1:1, *Lac. lactis subsp. lactis, Lac. lactis subsp. cremoris* and *Lb. casei)* Supported with 1ppm of inorganic selenium and incubate at 38 ° C for 4 h immediately before manufacturing.

Chemical methods:

Several pilots experimental were carried out for moisture, titratable acidity, salt, and fat were determined according to A.O.A.C (2000). pH was measured using digital pH meter 3310, Jenway Limited England, equipped with a glass electrode. The total nitrogen (TN) and water-soluble nitrogen (WSN) content was estimated by the semi micro Kjeldahl as described by (AOAC, 2012).

Tyrosine and tryptophan contents of cheese were determined by Vakaleris and Price (1959). Values were expressed as mg/100g of cheese.

Lipolysis in cheese during ripening was followed by determining the changes in the total volatile free fatty acids (TVFFA) using the method described by kosikowski (1982)

Selenium content of the digested samples was determined by Prokisch, *et.al.* (2006), and measurements of firmness and syneresis were determined according to Farooq and Haque (1992).

Plate count, Coliform, Yeast & Moulds and *Lactobacilli,* and *Streptococci count* following a method described by Marshall (1992).

Sensory evaluation of the examined cheese samples was evaluated according to El-Shafei *et al.* (2008) by the staff members of the Dairy Science Department, Faculty of Agriculture, Al-Azhar University, Assiut. The samples were presented to the panelists in random order, and evaluated for the flavor, body, and texture, appearance, and overall acceptability with modification of degree as follows 50, 40, 10, and 100 points, respectively.

RESULTS AND DISCUSSION

Total Se in cheese and cheese whey:

The total Se content in the control cheese and that of the Se-enriched cheese are shown in (Table 1) and. Fresh control cheese and after 60 days storage at refrigerator temperature showed a decrease in total Se content of the control sample than that of the experimental cheese, also a similar trend was observed in the control cheese whey sample.

Table 1. Concentration of total Se (µg /100g) in whey and white soft cheese on the first and after 60 days during of storage period at to 6±2 °C

Sample specie	Storage (days)	Control	Se-enriched cheese		
			T1	T2	T3
cheese	Fresh	5.8	61.2	80.1	102.0
	60	4.2	53.2	69.4	92.2
whey	Fresh	3.1	9.81	9.21	7.32
	60	2.5	20.8	16.5	11.20

Control= (without adding Se) T1= 0.5 ppm Se T2= 0.8 ppm Se T3= 1 ppm Se

However, the content total Se of Se-enriched cheeses was decreased gradually during the storage period and reached the maximum concentration in cheese age at 60 days, while the highest content 92.2% was found in the T3 treatments. This decrease in total Se contents during the storage could be attributed to the bio-convert partially of inorganic Se to organic Se, by the microorganism residually in cheese and whey or the Se used in the fortification was already in a chelated form, so the chelating ability of casein did not make any remarkable effect on Se; instead, Se stayed unbound in the curd structure and diffused to the brine during ripening. These results are in agreement with those reported by Gulbas and Saldamli (2005).

Generally, the fortification of white soft cheese with Se led to an increase of cheese with more than double the Se content of cheese produced from unfortified control milk. The general trends of the results obtained in this work are by following par those reported by Pechova *et al.* (2008), Moldovan *et al.* (2008), Csapo *et al.* (2015).

Chemical composition of white soft cheese:

The effect of fortification with different levels of inorganic Se on the chemical composition of W. S. C during storage periods at refrigerator temperature at 6±2°C up to 60 days is presented in (Tab 2).

Dry matter contents (DM%)

The obtained data in (Table 2) revealed that the dry matter % in cheese made by adding different levels of inorganic Se was slightly significantly higher ($p<0.05$) compared with the control cheese. Also, differences in dry matter content were found between all treatments. These results are in agreement with those found by Gulbas and Saldamli (2005). Also, the dry matter content of Se-enriched cheese and control was increased significantly ($p<0.05$) with progressing the storage periods up to 60 days in most treatments.

Table 2. Chemical properties of white soft cheese fortified with Se during storage period at 6±2°C.

Chemical properties	Storage (days)	Control	Se-enriched cheese			Mean
			T1	T2	T3	
DM %	Fresh	34.1	34.7	35.3	36.0	35.0^{c}
	15	34.9	35.0	35.8	36.5	35.5^{cc}
	30	35.7	35.9	36.1	36.8	36.1^{bb}
	45	36.1	36.2	36.5	37.2	36.5^{ab}
	60	36.4	36.6	36.8	37.6	36.9^{aa}
Mean		35.4^{cc}	35.7^{bc}	36.1^{bb}	36.8^{a}	
Moisture %	Fresh	65.9	65.3	64.7	64.0	65.0^{aa}
	15	65.1	65.0	64.2	63.5	64.5^{a}
	30	64.3	64.1	63.9	63.2	63.9^{bb}
	45	63.9	63.8	63.5	62.8	63.5^{bc}
	60	63.6	63.4	63.2	62.4	63.1^{c}
Mean		64.6^{aa}	64.3^{ab}	63.9^{bb}	63.2^{c}	
Fat %	Fresh	20.1	21.1	21.0	21.0	20.8^{e}
	15	20.8	22.1	21.8	21.7	21.6^{d}
	30	21.3	22.7	22.5	22.4	22.2^{c}
	45	21.8	23.2	23.2	23.0	22.8^{b}
	60	22.2	24.0	23.9	23.8	23.5^{a}
Mean		21.2^{b}	22.6^{aa}	22.5^{aa}	22.4^{a}	
(F/DM) %	Fresh	58.9	60.8	59.5	58.3	59.4^{dd}
	15	59.6	63.1	60.9	59.5	60.8^{cd}
	30	59.7	63.2	62.3	60.9	61.5^{bc}
	45	60.4	64.1	63.6	61.8	62.5^{ab}
	60	61.0	65.6	64.9	63.3	63.7^{aa}
Mean		59.9^{bb}	63.4^{aa}	62.2^{a}	60.8^{b}	
Titratable acidity %	Fresh	0.24	0.22	0.20	0.19	0.21^{e}
	15	0.70	0.68	0.66	0.63	0.67^{d}
	30	0.85	0.80	0.76	0.71	0.78^{c}
	45	1.06	1.04	0.98	0.93	1.00^{b}
	60	1.42	1.38	1.38	1.36	1.38^{a}
Mean		0.85^{aa}	0.82^{aa}	0.80^{aa}	0.76^{a}	
pH	Fresh	6.62	6.71	6.73	6.75	6.70^{a}
	15	5.84	5.92	5.96	6.04	5.94^{b}
	30	5.05	5.22	5.24	5.41	5.23^{c}
	45	4.52	4.71	4.75	4.80	4.70^{d}
	60	4.30	4.43	4.46	4.56	4.43^{e}
Mean		5.27^{a}	5.40^{aa}	5.43^{aa}	5.51^{aa}	
Salt %	Fresh	4.03	4.10	4.09	4.23	4.11^{a}
	15	4.60	4.82	4.86	4.88	4.79^{d}
	30	5.60	5.68	5.73	5.80	5.70^{c}
	45	6.30	6.57	6.61	6.77	6.56^{d}
	60	6.50	6.60	6.76	6.79	6.66^{a}
Mean		5.41^{a}	5.55^{aa}	5.61^{aa}	5.69^{aa}	
(Salt/ Moisture) %	Fresh	6.11	6.28	6.32	6.61	6.33^{e}
	15	7.06	7.42	7.57	7.69	7.43^{d}
	30	8.71	8.86	8.96	9.17	8.92^{c}
	45	9.86	10.30	10.41	10.78	10.33^{b}
	60	10.23	10.40	10.70	10.88	10.55^{a}
Mean		8.40^{a}	8.65^{aa}	8.79^{aa}	9.03^{aa}	

Control= (without adding Se) T1= 0.5 ppm Se T2= 0.8 ppm Se T3= 1 ppm Se

Fat/Dry Matter (F/DM)

The obtained results in (Table 2) showed that the Se-enriched cheese had a higher significantly ($p<0.05$) of F/DM than that of control samples in most treatments. These results are in agreement with those found by Gulbas and Saldamli (2005) and Abd El-Aziz *et al.* (2007). In addition,

the data demonstrated that the F/DM increased significantly ($p<0.05$) with increasing storage periods up to 60 days at refrigerator temperatures in most treatments. These results are in agreement with those reported by Gulbas and Saldamli (2005) Zommara *et al.*, (2007).

Titratable acidity and pH values

The obtained results in the same Table demonstrated that the acidity percent and pH values increase and decrease significantly ($p<0.05$) with increasing the storage periods up to 60 days at refrigerator temperatures in all treatments, respectively. These results are in agreement with those reported by Khalifa and Wahdan (2015). The development of acidity during the refrigeration period is a direct response to converting the residual lactose in cheese into lactic acid by the available microflora (Mehanna *et al.*, 2002; Elewa *et al.*, 2009, and Moneeb, & El-Derwy, 2021)

Salt and Salt/ Moisture %

The white soft cheese that contains different levels of Na_2SeO_3 had higher values of salt and (salt/ moisture) %, not significantly ($p<0.05$) than that of the control samples. Also the salt contents percent of Se-enriched cheese and the control sample were gradually increased significantly ($p<0.05$) till the end of the storage periods (Table 2). These results are in agreement with those reported by Gulbas and Saldamli (2005) and Abd El-Aziz *et al.* (2007).

Proteolysis and Lipolysis in white soft cheese:

The obtained data in (Table 3) revealed that the soluble nitrogen (SN), total nitrogen (TN), SN/TN, and some free amino acid (tyrosine, tryptophan) in addition to total volatile free fatty acid (TVFFA) of W. S. C were affected by adding different levels of inorganic Se and during storage periods at refrigerator temperatures up to 60 days.

From the obtained results in (Table 3), it could be noticed that the Se-enriched cheese had higher SN, TN, and SN/TN ratios non significantly ($p<0.05$) than that in control samples in all treatments. This could be attributed to the higher protein of these experimented cheeses than that of control cheese. These results are in agreement with those reported by Gulbas & Saldamli (2005).

Also, results illustrated in the same table show the liberated quantity of the tyrosine and tryptophan (mg/100g cheese) increased gradually significantly ($p<0.05$) until the end of the storage period in all treatments. These results are in agreement with those reported by various Authors regarding soft cheese (Abd El-Aziz *et al*., 2012, Ismail *et al.*, 2011and Nagm El-diin (2010) found that the free amino acid increased gradually until the end of the storage period.

While were the obtained data in the same Table revealed that the content of TVFFA was significantly increased gradually ($p<0.05$) with increasing the storage periods up to 60 days of all treatments. This increase in the content of TVFFA could be attributed to lipolytic activity in addition to free fatty acids formation and higher titratable acidity percent in cheese during ripening. These results are in agreement with those reported by Khalifa and Wahdan (2015) and Batool *et al.* (2018).

On the other hand, the control sample had lower values of content TVFFA non significantly ($p<0.05$) than that of Se- W. S. C. Also, the TVFFA were increase significantly ($p<0.05$) with increasing addition of Na_2SeO_3 levels up to 1ppm in all treatments.

Table 3. Effect of fortification to cheese milk with different levels by Na_2SeO_3 on some indicators of ripening white soft cheese during storage period at 6±2°C.

Chemical properties	Storage (days)	Control	Se-enriched cheese			Mean
			T1	T2	T3	
SN %	Fresh	0.122	0.128	0.131	0.134	0.129^{e}
	15	0.198	0.201	0.204	0.207	0.203^{d}
	30	0.232	0.241	0.245	0.251	0.242^{c}
	45	0.253	0.258	0.264	0.270	0.261^{b}
	60	0.295	0.313	0.315	0.321	0.311^{a}
Mean		0.220^{a}	0.228^{aa}	0.232^{aa}	0.237^{aa}	
TN %	Fresh	1.35	1.38	1.39	1.42	1.39^{e}
	15	2.10	2.12	2.14	2.16	2.13^{d}
	30	2.40	2.41	2.43	2.45	2.42^{c}
	45	2.50	2.52	2.54	2.57	2.53^{b}
	60	2.58	2.68	2.70	2.73	2.67^{a}
Mean		2.19^{a}	2.22^{aa}	2.24^{aa}	2.27^{aa}	
(SN/TN) %	Fresh	9.0	9.3	9.4	9.4	9.3^{d}
	15	9.4	9.5	9.5	9.6	9.5^{dd}
	30	9.7	10.0	10.1	10.2	10.0^{c}
	45	10.1	10.2	10.4	10.5	10.3^{b}
	60	11.4	11.7	11.7	11.8	11.6^{a}
Mean		9.9^{a}	10.1^{aa}	10.2^{aa}	10.3^{aa}	
Tyrosine (mg/100g)	Fresh	22.1	22.5	22.8	23.7	22.8^{e}
	15	40.5	41.6	45.0	46.9	43.5^{d}
	30	62.7	60.5	65.1	65.3	63.4^{c}
	45	78.0	81.3	82.5	83.2	81.3^{b}
	60	80.8	82.6	91.7	91.8	86.7^{a}
Mean		56.8^{a}	57.7^{aa}	61.4^{aa}	62.2^{aa}	
Tryptophan (mg/100g)	Fresh	130.0	133.9	134.2	134.9	133.3^{e}
	15	143.3	150.6	151.7	152.6	149.6^{d}
	30	157.2	163.2	165.5	167.3	163.3^{c}
	45	165.2	170.2	173.3	174.6	170.8^{b}
	60	168.2	171.1	179.2	181.4	175.0^{a}
Mean		152.8^{a}	157.8^{aa}	160.8^{aa}	162.2^{aa}	
TVFFA (ml 0.1 N NaOH/100 g cheese)	Fresh	4.75	4.80	4.85	4.87	4.82^{e}
	15	8.00	8.06	8.08	8.15	8.07^{d}
	30	9.60	9.82	10.05	10.44	9.98^{c}
	45	12.00	12.18	12.62	12.73	12.38^{b}
	60	13.20	13.80	14.05	14.13	13.80^{a}
Mean		9.51^{a}	9.73^{aa}	9.93^{aa}	10.06^{aa}	

Microbiological quality of white soft cheese:

Show data presented in (Table 4) illustrate the total viable bacterial, *Lactobacilli*, *Streptococci*, yeast & molds and coliform counts of W. S. C made with different levels of inorganic Se during the storage periods at refrigerator temperature for 60 days.

The cheese fortified with different levels of Na_2SeO_3 had higher counts of *Lactobacilli* and *Streptococci* compared with the control sample. Also, the *Lactobacilli* and *Streptococci* counts increased with the increasing addition of Na_2SeO_3 levels up to 1ppm, and the *Streptococci* counts had higher than the *Lactobacilli* counts. While the yeasts & molds were not detected in fresh cheese or after two weeks of storage. They were detected and increased gradually with the progress of storage at 30 days up till 45 days.

Show these results are in harmony with those of Fayed *et al.* (2001); Aly and Galal (2002); Tammam *et al.* (2011); Liu *et al.* (2015) and Moneeb, and El-Derwy (2021).

Table 4. Total Counts of some microbial groups (Log cuf/gm) of white soft cheese Fortified with Se during storage periods at refrigerator temperatures up to 60 days.

Microbial type	Storage (days)	Control	Se-enriched cheese		
			T1	T2	T3
Total plate count	Fresh	5.5	6.2	6.5	7.1
	15	7.8	8.1	8.4	8.7
	30	9.0	9.4	9.7	10.1
	45	9.7	10.0	10.4	10.7
	60	8.2	8.6	9.0	9.3
Lactobacilli count	Fresh	2.3	3.3	3.5	3.8
	15	5.1	5.7	6.0	6.2
	30	5.9	6.2	6.6	6.8
	45	6.3	6.5	7.1	7.4
	60	5.2	5.4	5.8	6.2
Streptococci count	Fresh	5.3	5.5	5.8	6.2
	15	7.0	7.2	7.7	8.0
	30	7.5	7.7	8.1	8.6
	45	7.9	8.1	8.7	9.1
	60	5.8	6.2	6.5	6.8
Yeasts & moulds count	Fresh	ND	ND	ND	ND
	15	ND	ND	ND	ND
	30	6.6	4.8	3.5	2.6
	45	9.2	5.2	4.1	2.9
	60	5.7	3.5	1.8	ND
Coliform bacteria		ND*			

* **Not- detected**

Some Physic-chemical properties of white soft cheese made with different levels of Na_2SeO_3:

Data presented in (Table 5) illustrates some Physico-chemical properties such as Firmness and Syneresis of cured in addition to yield ratio calculation for W. S. C made with levels different of Na_2SeO_3 and control sample during fresh age (curd) from the made. The control cheese had the highest both the firmness and syneresis value than the Se-enriched cheese. While the yield ratio of the control sample was the lowest value than the treated cheese Also control cheese was harder than the Se cheese. A similar trend for these results of white soft cheese was found by Abd El-Aziz *et al*. (2007 and 2012) in mozzarella cheese and Liu *et al.* (2015)

Table 5. Some physico-chemical properties and yield percent of white soft cheese fortified with Se during fresh age (curd) from the made.

Components	Control	Se-enriched cheese		
		T1	T2	T3
Firmness (gm)	38.5	38.0	37.5	36.0
Syneresis (ml/100 gm)	22.6	21.3	18.7	14.8
Yield (%)	30.1	32.8	33.6	35.8

Organoleptic properties of white soft cheese:

Data presented in (Table 6) illustrate the organoleptic properties of white soft cheese made with different levels of Na_2SeO_3 during storage periods at refrigerator temperatures up to 60 days. The obtained data showed that the T1 and T2 sample had the highest values of total scores than that the other treatments in most ages for storage. This result was in agreement with (Gulbas and Saldamli, 2005), soft cheese Abd El-Aziz *et al.* (2007) in Domiati cheese. And in cheddar cheese by Batool *et al.* (2018)

The control sample recorded the lowest value of total scores during the storage period up to 60 days than that of the other treatments.

Generally, from the foregoing results, it could be concluded that white soft cheese can make with different levels of Na_2SeO_3 up to 0.8 ppm and stored at refrigerator temperature for 60 days. we can fortify the white soft cheese with Se as a role antioxidant and benefit from the therapeutic properties of many diseases without the affected occurrence of undesirable changes in the product.

Table 6. Organoleptic properties of white cheese fortified with Se during storage periods in refrigerator temperatures up to 60 days.

Properties	Storage (days)	Control	Se-enriched cheese		
			T1	T2	T3
Flavor (50)	Fresh	48.3	46	47.3	45.3
	15	47.3	44	40.7	38.3
	30	41.3	42	42.7	38.3
	45	45.3	46	44.7	42.3
	60	42.7	45	46.3	45.3
Body & Texture (40)	Fresh	36.0	36.0	36.4	36.2
	15	32.3	36.7	35.0	33.0
	30	36.7	36.7	36.7	34.3
	45	36.3	37.3	37.0	36.0
	60	34.0	37.0	39.0	38.0
Appearance (10)	Fresh	8.7	8.3	7.7	8.3
	15	8.2	9.0	8.7	8.3
	30	8.3	8.3	8.7	8.0
	45	8.7	9.3	9.3	9.0
	60	8.3	9.7	9.7	9.7
Total score (100)	Fresh	93.0	92.0	92.0	88.7
	15	87.8	89.7	84.0	79.7
	30	86.3	87.3	88.0	80.7
	45	90.3	92.7	91.0	87.3
	60	85.0	91.7	95.0	93.0

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تأثير السيلنيوم على الخواص الوظيفيه للجبن الابيض الطرى

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يهدف البحث الي انتاج جبن ابيض طرى مصنع من اللبن الجاموسى مدعم بعنصر السلينيوم لما له من فوائد تغذوية وصحية عالية وايضا لانخفاض اللبن ومنتجاته من عنصر السلنيوم. ودراسة مدي تأثير هذا العنصر علي بعض الخواص الكيميائية والميكروبيه والريولوجية والحسية للجبن المدعم به حيث تم إضافة ثلاث تركيزات مختلفة (0.5, 0.8, 1.0جزء في المليون) من سيلينات الصوديوم غير العضوي الي اللبن المعد لعمل الجبن, مع عمل عينة للمقارنة دون اضافة سيلنيوم وتخزينه علي درجة حرارة الثلاجه حتي 60 يوم. أوضحت النتائج أن هناك زيادة طفيفه في كلا من الجوامد الكلية والنتروجين الكلي والحموضه بزيادة إضافة السيلينوم, بينما نسبة الدهن لم تتأثر بهذه الإضافة. عند إضافة 0.6جزء في المليون سلينيوم غيرعضوي أدي إلي إنخفاض طفيف في الحموضه اثناء التخزين حتي60 يوم, وكان هناك زيادة في التماسك والكثافة وانخفاض التشريش في الجبن المدعم مع إضافة السلينيوم مقارنة بعينة الكنترول. أوضحت النتائج زيادة كلا من بكتريا حامض اللاكتيك الكرويه والعصويه عند التركيزات المذكورة مقارنة مع الكنترول خلال فترات التخزين المختلفة مع عدم ظهور اي تأثير سلبي علي العدد الكلي للبكتريا, لكن ليس هناك نموات لبكتريا القولون في كل المعاملات بالإضافه إلي الكنترول خلال التخزين علي البارد. أظهر التحكيم الحسي للجبن المدعم بالسيلنيوم تحسين في القوام والتركيب مع ثبات المظهر العام واللون للجبن مقارنة بالكنترول. لذلك يمكننا تدعيم اللبن لتصنيع الجبن الابيض الطرى بعنصر السيلنيوم حتي 1.0جزء في المليون كأحد العناصر النادره المضاده للاكسدة والاستفاده من خواصه العلاجيه لكثير من الأمراض دون تأثير واضح علي البادئ المستخدم أو حدوث تغيرات غير مرغوب فيها بالمنتج.