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Minerals composition (Ca, Na, Pb and Sn) of Sudanese white soft cheese

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A B S T R A C T

Minerals composition (Ca, Na, Pb and Sn) of Sudanese white soft cheese purchased from White Nile state had been investigate, the cheese samples were packed in to 5 different packaging techniques, metal tin (lined with polyethylene bags and non-lined), plastic container (lined with polyethylene and non-lined) and petroleum gallon as a control. The Calcium and Sodium content decreased significantly ($P \leq 0.05$) throughout the storage period from 9.5 and 11.13 ppm at the beginning of the storage period to 7.0 and 2.47 ppm at the end of the storage (180 days) respectively, where there were no significant differences between samples kept in lined and non-lined metal tin packages. The significantly higher level of Lead (0.05 ppm) was observed in samples stored in metal gallons sealed by soldering at 60 days storage whereas the significantly ($P \leq 0.05$), lowest value 0.026 ppm of Pb content was observed in samples stored in plastic container at 120 days storage. The Tin content in all samples was under the detected level.

1. Introduction

Goyer (1995) stated that minerals and trace elements occur in the body in a number of chemical forms, such as inorganic ions and salts or as constituents of organic molecules, for example protein, fat, carbohydrates and nucleic acid. The minerals that are considered essential in human diet are sodium, potassium, chloride, calcium, magnesium, phosphorous, iron, copper, zinc, manganese, selenium, iodine, cobalt, molybdenum, florid, arsenic, nickel, silicon and boron. A number of other chemical elements occur in food, e.g. aluminum, lead; tin, mercury, cadmium and many of them are toxic. Birghila.,et.al (2008) reported that many dangerous elements or compounds, such as metals and metalloids, accumulate along the food chain. Furthermore their concentrations in the environment grow with the increase of urban, agricultural, and industrial emissions. The almost ubiquitous presence of some metal pollutants, especially Cd and Pb, facilitates their entry into the food chain and thus increases the possibility of their having toxic effects on humans and animals. Although heavy metals have industrial uses, their potential toxicity for people and animals is the object of several studies. For some elements the effects are accumulative and it is necessary to control their level in consumed food. Increasing metal concentration in food over the limits can cause toxic effects for consumers of these products. The gravity of toxic effect depends on nature, quantity and chemicals form of metals from the food product and it depend on metal concentration. Milk and dairy products become contaminated with heavy metals either through food stuff and water or through manufacturing and packaging processes (Ayar et al., 2009). Guicherit (1972) stated that, the total lead intake from food and beverages has been estimated for adults in various industrialized countries to be 250-300 µg/day. Cheese and dairy products may contain different amount of Pb between 0.3-5.49 ppm. The maximum limits allowed for lead content in dairy product are 0.1 ppm for milk, 0.4 ppm for processed cheese and 0.5 ppm lead for cheese. GEMS/food regional diets,(2003) stated that the maximum limits of lead for milk and secondary milk products were taken as 0.05 ppm each, the total exposure in the European diet (European diet provides maximum potential for weekly intake of lead through food) would be 4.63l g of lead per kg body weight According to Hartwell (1951), the tin is not considered as a poisonous metal but very long doses produces serious digestive disturbances. Most of the tin present in canned foods is insoluble in the gastric and intestinal juices, and it is not absorbed during the process of digestion.

In general, cheese supplies a great deal of calcium and phosphorous. El-Abd et al. (1982) mentioned that 50% of the calcium and less than 20% of the phosphorous passed in cheese serum at 14 days of storage

Tin plate is light gauge, steel sheet or strip, coated on both sides with commercially pure tin and has been used for well over a hundred years as a robust form of food packaging. The use of tin plate for food and beverage packaging will result in some dissolution into the food content, particularly when plain uncoated internal surfaces are used. The recommended maximum permissible levels of tin in food are typically 250 µg/kg. The highest levels being found in products packaged in un-lacquered or partially lacquered tin plate cans (Wallace and Blunden, 2003).

Dissolution of the tin plate depends on the food matrix, acidity, presence of oxidizing reagent (nitrogen, iron and copper), and presence of air (oxygen) in the headspace, time and storage temperature. To reduce corrosion and dissolution of tin now a day cans are usually lacquered (Dvorzak and Perring, 2002). There are many types of lacquer used for coating packaging materials used in food industry; the most commonly used type is the Golden lacquers, which resist the effect of Sulphur and acid in both salty and sweet stuff. In addition, they are taste free and odorless and don’t affect the canned foods (Leonard, 1987).

Plastics and polymers have become a part of our life today. In fact they have become as essential to mankind as food and water. There is no sphere of human activity in which plastics have not made their entry ranging from agriculture, chemical industry, and packaging, etc. Singh (2001) reported that plastics we generally come across are not considered to be toxic or harmful in any way. They are even safe even if they come in contact with food. In fact, most of the polymers may be consumed orally without any ill effects, as they are inert and do not react with the chemicals in our body

White cheese is the main and traditional form of cheese made and consumed in Sudan. The objective of this study is investigate the presence of Lead, Tin, Calcium and Sodium in the Sudanese white cheese packed in metal and plastic containers during the storage period.

2. Materials and methods

The cheese used in this research was purchased from galaja 70 kilometers south Eldueim 350 kilomers southwest of Khartoum (Sudan). The purchased cheese was packaged into 5 different type of packing, metal tin (lined with polyethylene bags and non lined), plastic container (lined with polyethylene and non lined) and petroleum gallon. The tin containers were made from tinplate the inside were coated by golden lacquer and the outside was coated by white paint. The tin was square, with push-on-closures and 2 kg size. Plastic containers were white, square, the cover lined with adhesive tape, and 2 kg size. The Petroleum Gallon were 2kg size sealed by soldering.

The sodium, calcium, lead and tin content were determined using the atomic absorption spectrophotometer. A 2 gm cheese were maintained in a muffle furnace at 550˚C for 4 hrs, samples were cooled and 10 ml of 3 N HCl was added, covered with watch glass and boiled gently for 10 minules, then cooled, filtered, diluted to volume (100 ml) with distilled water, and taken for determintion of sodium, lead, and tin contents, for determintion of calcium, 1 ml of 1% lanthanum chloride was added to final dilution (Perkin Elmer, 1994).

3. Results and discussion

3.1. Calcium content

Table 1 shows the calcium content of the white soft cheese as affected by the storage period. The calcium content of the soft cheese significantly ($P \leq 0.05$) decreased throughout the storage period, the intial value of 9.5 p.p.m, then decreased gradually to be 7.0 p.p.m towards the end of the storage period (180 days). These findings agreed with those obtained by Abdel Razig (2000), who stated that the calcium content of the braided cheese significantly ($P \leq 0.05$) decreased as the storage time progressed, and mentioned that the higher the acidity the higher the calcium losses in whey. Amer et al. (1979) also reported a decrease in calcium of Kashkaval cheese during ripening. Wong et al. (1988) reported that the solubility of calcium and phosphorus salts in the acidic medium lead to the loss of both of them. At 30 days of storage there were no significant ($P \leq 0.05$) differences between sampels kept in metal tin and plastic containers on one side and between plastic lined with polyethylene and metal gallon on the other. The lowest calcium values were observed at the end of the storage period, in which there was no significant difference ($P \leq 0.05$) between lined metal tins and non lined. The loss in calcium content was attributed to the increase in acidity (E1 – Abd et al., 1982).

Table 1
Changes in calcium content (ppm) of Sudanese white soft cheese during storage period as affected by type of packaging*.

Packaging type	Storage period (days) 0	30	60	120	150	180
MT	19.50^{a}	8.750^{efg}	10.50^{bcd}	10.25^{bcd}	6.600^{h}	7.000^{h}
MTL	19.50^{a}	8.000^{fgh}	9.250^{def}	8.500^{efg}	6.875^{h}	7.125^{h}
P	19.50^{a}	8.750^{efg}	10.73^{bc}	9.375^{cdef}	6.740^{h}	7.065^{h}
PL	19.50^{a}	7.750^{gh}	11.27^{b}	9.375^{cdef}	6.740^{h}	7.065^{h}
MG	19.50^{a}	7.750^{gh}	9.625^{cde}	9.375^{def}	6.740^{h}	7.065^{h}

* Mean values having different superscript letters in columns and rows differ significantly ($P \leq 0.05$).

Where:
MT = Metal tin
MTL = Metal tin lined with polyethylene bags
P = Plastic
PL = Plastic lined with polyethylene bags
MG = Metal gallon

3.2. Sodium content

Table 2 shows changes in sodium content of soft cheese content during the storage period. A significant decrease in sodium content of cheese was observed throughout the storage period. The initial value was 11.13% decreased gradually to 2.47% at the end of the storage (180 days), these results were different from values observed by Abdel Razig (2000) who stated that the sodium content of braided cheese increased significantly ($P \leq 0.05$) with storage time. cheese sample kept in metal tin containers at 60 days were significantly ($P \leq 0.05$) higher (6.75) compared to the other containers. The lowest values obtained for samples kept in lined and non lined tin cans were 2.47 and 2.62, respectively, at the end of the storage period (120 days). The increase in sodium content correlated well with the decrease in moisture content. Abdel Razig (2000) attributed the high sodium content of braided cheese to the high loss in its moisture content.

Table 2
Changes in sodium content (ppm) of Sudanese white soft cheese during storage period as affected by type of packaging*.

Packaging type	Storage period (days) 0	30	60	120	150	180
MT	11.130^{a}	3.000^{efg}	6.750^{b}	4.500^{d}	3.375^{ef}	2.475^{g}
MTL	11.130^{a}	3.100^{efg}	5.950^{c}	4.590^{d}	3.050^{efg}	2.625^{fg}
P	11.130^{a}	3.600^{e}	6.250^{bc}	4.600^{d}	3.215^{efg}	2.550^{g}
PL	11.130^{a}	3.075^{efg}	5.100^{d}	4.600^{d}	3.215^{efg}	2.550^{g}
MG	11.130^{a}	4.850^{d}	5.875^{c}	4.600^{d}	3.215^{efg}	2.550^{g}

* Mean values having different superscript letters in columns and rows differ significantly (P ≤ 0.05).

3.3. Lead content

Table 3 shows changes in lead content of soft cheese during storage. The values of lead content in soft cheese kept in metal tin cans was 0.0480 ppm at the beginning of the storage and become 0.05 ppm after 180 days of storage, such results showed a non significant (P ≤ 0.05) variation between the samples during the storage period. These values were lower than the general limit which is ranged between 1.0-2.0mg/Kg and 0.2 mg/Kg for foods specially prepared for infants (Egan et al., 1976). The significantly (P ≤ 0.05) highest value (o.412%) was obtained in samples stored in metallic gallon sealed by soldering at 60 days storage which lower than the maximum limit of lead content 0.5 allowed for cheese (Guicherit, 1972). Korfali and Abou Hamdan (2013) reported that the lead might exist in canned food stuff due the leaching from the soldering materials. The values showed that there were no significant (P ≤ 0.05) differences in lead content among cheese samples kept in different types of containers at 30 days storage. The significantly (P ≤ 0.05) lowest value 0.026 ppm of Pb content was found in samples stored in plastic container at 120 days storage. The Pb content of cheese samples packed in metallic gallon sealed by soldering was increased significantly (P ≤ 0.05) at 60 days storage, which could be attributed to the fact that the cans were not food grade containers beside the use of solder in sealing them value, Birghila et,al (2008) attributed the presence of Pb in milk samples to various factors such as the transhumance along roads and/or motorways, fodder contamination, climatic factors, such as winds, and the use of pesticide compounds. One of the most important sources of lead contamination in milk is water, especially in more contaminated areas (Codex Alimentarius Commission, 2003)

The results show that the tin content of cheese samples was below detection limits (<1.0 ppm), the maximum permissible levels of tin in food (250 mg/kg), (Blunden and Wallace and, 2003, JEFAC, 2006).). The significantly lower tin values in the cheese sample because of the the fact that the metal containers were lacquered beside the use of lining polyethylene bags. Korfali and Abou Hamdan (2013) atributtede the high level of tin in Lebanese marketed canned food to the use unlacquered cans with high percentage of tin.

Table 3
Changes in lead content (ppm) of Sudanese white soft cheese during storage period as affected by type of packaging*.

Packaging type	Storage period (days) 0	30	60	120	150	180
MT	0.0480^{l}	0.0770^{c}	0.0665^{h}	0.0390^{q}	0.0460^{m}	0.0450^{n}
MTL	0.0480^{l}	0.0400^{p}	0.0970^{a}	0.0675^{g}	0.0740^{f}	0.0500^{k}
P	0.0480^{l}	0.0910^{b}	0.0760^{d}	0.0260^{r}	0.0600^{j}	0.0615^{i}
PL	0.0480^{l}	0.0615^{i}	0.0750^{e}	0.0440^{o}	0.0600^{j}	0.0615^{i}
MG	0.0480^{l}	0.0680^{g}	0.0970^{a}	0.0440^{o}	0.0600^{j}	0.0615^{i}

* Mean values having different superscript letters in columns and rows differ significantly (P ≤ 0.05).

4. Conclusion

Occurrence of high level of trace metals such as lead is associated with storage of cheese in metallic gallons. In this context, Sudanese white soft cheese must be packed in lined containers made either of plastic or metal. Suitable lining material such as polyethylene can be used for such purpose. Singh (2001) reported that plastics we generally come across are not considered to be toxic or harmful in any way. They are even safe even if they come in contact with food. Further studies are necessary to evaluate the contents of ''essential'' and ''toxic'' heavy metals on Sudanese white cheese collected from different areas. There is always a possibility that a small amount of monomer might be present in the plastic in an uncombined form. Therefore, the level of unreacted monomer has to be closely monitored in case of such plastics.

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