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EFFECT OF MINERAL COMPOSITION ON THE ELECTRICAL CONDUCTANCE OF MILK

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Abstract

Milk electrical conductance is affected mostly by its mineral composition. Conductivity is a nonselective measurement, any charged ion contributing to the total conductivity. The goal of the study was to establish the correlations between this physical parameter and some inorganic milk components. The experimental data revealed no correlation between electric conductance and Ca, Mg and K, and positive correlation between electric conductance and Cl and Na.
Keywords: *electrical conductance, sodium, chloride, calcium, potassium, magnesium*

Introduction

The electrical conductance (EC) of a solution is a measure of the ability of a solution to conduct a current. It is a property attributable to the ions in solution. Electrical current is transported through solutions via movement of ions, and conductivity increases as ion concentration increases. The conductivity of a solution is measured between two spatially fixed inert electrodes of known surface area. Conductance is directly proportional to the electrode surface area and inversely proportional to the distance between the electrodes. In the international system of units, conductivity is reported as Siemens per meter (S/m).

Conductivity is a nonselective measurement with any charged ion contributing to the total conductivity. Solutions with higher number of ions present in the liquid will have a higher conductivity. Organic compounds do not dissociate (ionize) in water and therefore have little or no effect on conductivity.

Milk is a complex food with over 100000 different molecular species found (Jensen, 1995). Milk is an aqueous solution (87.3% water), containing organic (fat, protein, lactose, vitamins, enzymes) and inorganic components (Ca, P, Mg, Na, K, Cl, etc). Milk's physical characteristics are affected by several factors including the composition and processing of milk (Caprita, 2001).

Experimental

The experiment had in view to study the contribution of the various mineral components in cow's milk to its electrical conductivity. The electrical conductance (σ) of the milk samples was measured with conductivity meter type OK-102/1 (Radelkis). The instrument was standardized with KCl solutions of known conductance before use. The cell was washed with 0.01 M KCl followed by one to two rinses with the sample prior to measurement. Temperature corrections were made, as the samples were not analyzed at 25°C. The mineral composition was assayed with the standardized analytical methods (Caprita, 2002).

Results and Discussions

The analytical data presented in Table 1 and the graphical representation (Figure 1) reveals the positive correlation between the electrical conductance and the total ion concentration.

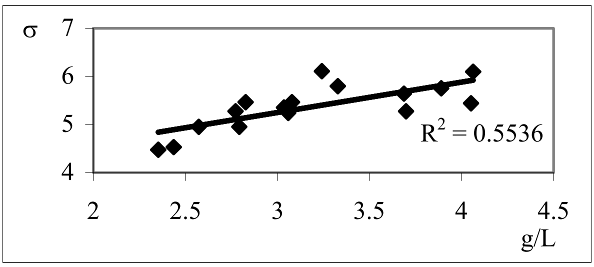

Fig. 1. Correlation between the conductivity and the total ion concentration

For observing the contribution of each ion to σ, the concentrations were plotted against the electrical conductance (Figures 2 - 6).

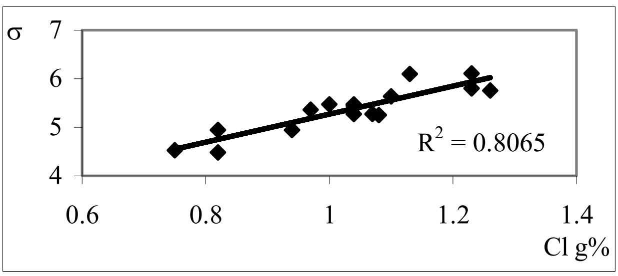

Fig. 2. Correlation between the conductivity and Cl

Table 1. Mineral content and electrical conductance of milk samples

Sample	Ca (g/L)	Mg (g/L)	K (g/L)	Na (g/L)	Cl (g/L)	σ (mS/cm)
1	0.65	0.122	0.50	0.26	0.82	4.48
2	0.46	0.089	0.50	0.38	1.26	5.76
3	0.59	0.096	0.80	0.20	0.75	4.53
4	0.65	0.124	1.70	0.28	0.94	4.95
5	0.85	0.119	0.80	0.31	1.00	5.47
6	0.80	0.116	1.30	0.37	1.10	5.64
7	0.59	0.109	1.70	0.26	1.04	5.28
8	0.59	0.124	1.70	0.52	1.13	6.10
9	0.80	0.122	1.70	0.39	1.04	5.44
10	0.73	0.109	0.80	0.46	1.23	5.8
11	0.73	0.137	0.80	0.40	0.97	5.36
12	0.80	0.112	0.60	0.50	1.23	6.11
13	0.59	0.127	0.70	0.37	1.04	5.47
14	0.65	0.093	0.65	0.31	1.07	5.28
15	0.65	0.082	0.65	0.37	0.82	4.95
16	0.65	0.140	0.80	0.39	1.08	5.25

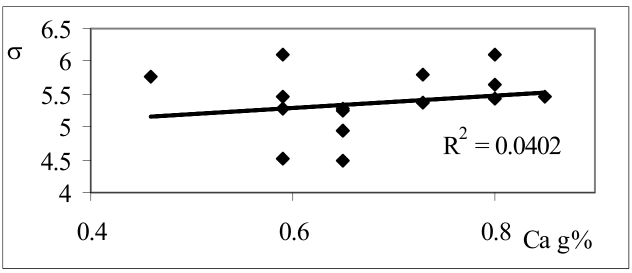

Fig. 3. Correlation between the conductivity and Ca

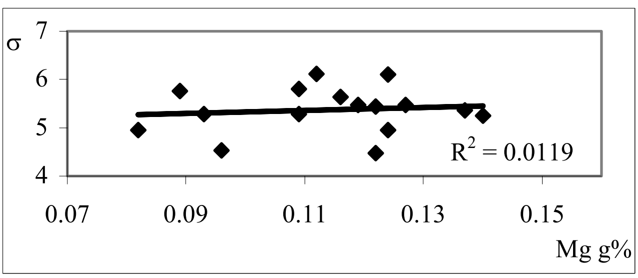

Fig. 4. Correlation between the conductivity and Mg

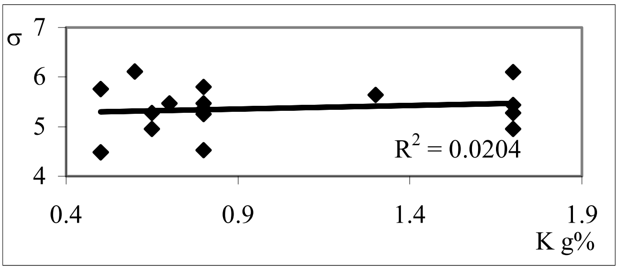

Fig. 5. Correlation between the conductivity and K

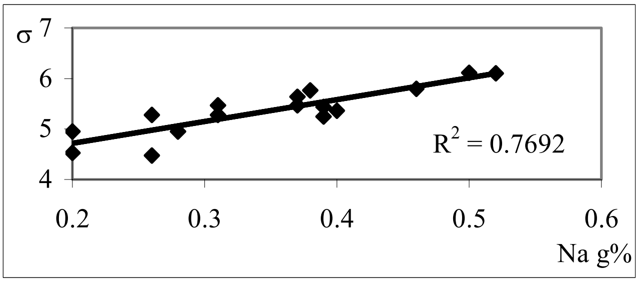

Fig. 6. Correlation between the conductivity and Na

The electrical conductance is highly correlated to the chloride and sodium concentration. The contribution of Mg, Ca and K are insignificant.

Conclusions

The experimental data revealed no correlation between electric conductance and Ca, Mg and K, and positive correlation between electric conductance and Cl and Na.

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