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Total contents of major minerals in the nature yoghurt and in the yoghurts with the date powder of three dry varieties

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ABSTRACT

In this paper we report on the content of major minerals (calcium, magnesium, sodium, potassium, iron and zinc) in the nature yoghurt (without sugars) and three yoghurts added with date powders. The latter's were from three dry date varieties (Mech-Degla, Degla-Beida and Frezza). The elements determination was carried out using atomic absorption spectrometry after mineralization processing. Total mineral content showed a great difference between the yoghurt nature and yoghurts enriched by date powder fruits. In the yoghurts added with date powder, following results were found (in mg/Kg): calcium (2213.31-2938.67), sodium (783.37-959.36), potassium (725.68-771.77), magnesium (169.54-267.85), iron (9.6-11.52), zinc (1.29-7.93). Concerning the natural yoghurt the values obtained were (in mg/Kg): calcium (1950.41), Sodium (684.72), potassium (540.58), magnesium (132.16), iron (5.26), zinc (0.35). These results are in positive interrelationship with those of the rheological properties.

Keywords: Yoghurt, calcium, magnesium, sodium, potassium, iron, zinc, date.

INTRODUCTION

Recent years have witnessed a significant use of plants, mainly fruits. They arouse a growing interest among consumers, dieticians and nutritionists. They are used, moreover, in the preparation of food of high energy value and dietetics: "yoghurt, flour for babies, jams, marmalades."

It should be noted that products based on dates have already been developed. These include Ketchup (Mikki *et al*, 1987), biscuits (Siboukeur, 1997), ice (Greiner, 1998), Tamarheep (a mixture of flour of dates and milk) (El Nakhal *et al* 1987), flour of dates and yogurt with extract of dates (Benamara *et al* ,2004).

This work aims to enhance the value of the dry dates: Mech-Degla, Degla-Beida and Frezza in particular, the objective being their eventual transformation into powder after drying under vacuum. This powder is used as an ingredient for the enrichment of yoghurt. The targeted objectives are numerous: (1) Substitution of granulated sugar, taking in to account the high sugar content of certain date varieties (70 % dry basis); (2) Substitution of artificial flavourings usually added to yoghurt, (3) Using the powdered dates as texture agent (thickening and / or gelling) having regard to its richness in fibre and pectin; (4) enrichment of the prepared yoghurt with dates minerals (Ca, P, K, Fe,…) and other substances biologically active (Group B vitamins, essential amino acids, polyphenols).

With these objectives, we expect to result to the formulation of a product which is functional in line with the expectations of consumers in the modern era.

It is well known that fresh fermented dairy products such as yoghurt are widely consumed foods in many countries. The yogurt is one of the most dairy products sold on the market because of the diversification of the range available: reduced fat yoghurt, probiotic yoghurt, yoghurt mousse, ice cream yoghurt, liquid yoghurt for drinking (Fiszman *et al*, 1999). The yoghurt itself, in addition to its nutritional importance, has been identified as a healthy food due to its beneficial alive bacteria .These is in competition with pathogenic bacteria in both the food and the environment (Tamime and Robinson, 1985)

MATERIALS AND METHODS

Dates varieties: The varieties of dates included in this study are widespread in the palmgrove of South-East region of Algeria. Three varieties were chosen: Mech-Degla, Degla-Beida and Frezza.

The Mech-Degla variety has a sub-cylindrical form, slightly narrowed at the end. At maturity, it becomes rather light beige tinged with a little light brown. The

epicarp is wrinkled, little bright and easily broken. The mesocarp is of little consistency, dry and of fibrous texture (Buelguedj, 1996) .

Degla-Beida is slender. It is flat on the side of the perianth and narrowed on the other end. A full maturity, it is beige. The epicarp is thick and smooth. The mesocarp is fleshy, with a dry consistency and a floury texture (Buelguedj, 1996).

The Frezza dates (consisting really in Deglet Nour variety dried on the tree when weather conditions are unfavourable) has a slender form sometimes egg-shaped, slightly flattened at the perianth side. At maturity, the date is amber with a smooth bright epicarp, easily folded once the dates softened. The mesocarp is thin with a dry consistency and a fibrous texture (Buelguedj, 1996).

The choice of these varieties is justified by their good taste, their abundance at the national level and their preservation ability (dry dates).

The milk used for the manufacture of yoghurt: The milk used is a full cream dehydrated powdered milk brand NESPRAY.

The lactic ferments: The lactic ferments used are represented by *Streptococcus thermophilus* and Lactobacillus bulgaricus at a freeze-dried state.

The date powders used for manufacture of yoghurt: The date powders are obtained after drying at 80°C followed by grinding and sifting.

Yoghurt Making : The preparation of yoghurt is made in a laboratory respecting the diagram for making standard yoghurt with a modification concerning the substitution of white sugar with powdered dates. Adding it takes place before heat treatment. The adapted recipe is the one determined within the work which is included in our research project and patented in 2004 and it is presented (with standard yoghurt as a reference) in table 1.

Table 1: Recipe of standard yoghurt and yoghurt with the dates powders (100g)

Recipe	Powder of milk (g)	Sugar (g)	Powder of dates (g)	Water (ml)	Lactic Ferment (%)
Standard Yoghurt	13.7	0	0	100	0.03
Yoghurt with Powder of dates	13.7	0	12.5	100	0.03

Analysis of minerals: The mineral elements are determined by Atomic Absorption Spectrophotometry. In atomic absorption concentration is derived from measuring the absorption of light by atoms of the element stayed in the fundamental state when they are illuminated by a suitable source of light. The measurement of light intensity is made at a specific wavelength of the element to be determined.

RESULTS AND DISCUSSION

The minerals content of the four yoghurts produced are illustrated in Table.2:

The analysis of results given in Table. 2 highlighted the following points:

The three-yoghurts to which we added powdered dates are richer in minerals than the plain yoghurt. This is may be due to the richness of the dates in minerals.

- The content of calcium YF seems very high as those of other yogurts (YB, YM, YT), since it is equal to 2938.67 (mg / kg) against 2350.25, 2213.31 and 1950.41 (mg / kg) for YB, YM and YN respectively. The calcium in plain yoghurt is variable: 1525 mg / kg (Wang and Singh, 1978), 1355 mg / kg (Moreno Rojas *et al*, 1993), 2000 mg / kg (Buttriss, 1997) and 1112 mg / Kg (Garcia Martinez *et al*, 1998). (Sanchez-Segarra et al, 2000) have reported values of 990 mg / kg for a strawberry yogurt, 1009 mg / kg for a yogurt with blackberries, 1047 mg / kg for a yogurt added to a mixture of fruits, 917 mg / kg for a yoghurt with normal peaches, 881 mg / kg for a yoghurt with the yellow peaches, 964 mg / kg for a yogurt with red peaches and 1056 mg / kg for yogurt with pineapples. As you can see, these figures are lower than those found in this study.

Table 2: Minerals content of the yoghurt produced (mg / kg)

Sample	Ca^{+2}	Na^{+}	K^{+}	Mg^{+2}	Fe^{+3}	Zn^{+2}	Pb^{+2}	Mn^{+2}	Cd^{+2}
YF	2938,67 ± 21,54	959,36 ± 41,72	725,68 ± 63,67	200,67 ± 12,71	9,60 ± 1,48	7,93 ± 0,589	<0,42 ± 0	0,56 ± 0,05	<0,42 ± 0
YB	2213,31 ± 17,85	918,71 ± 7,73	756,71 ± 22,73	267,85 ± 32,42	10,49 ± 0,89	2,74 ± 0,34	<0,36 ± 0	0,44 ± 0,014	<0,36 ± 0
YM	2350,25 ± 27,33	783,37 ± 20,58	771,77 ± 22,18	169,54 ± 8,65	11,52 ± 1,28	1,29 ± 0,18	<0,38 ± 0	0,49 ± 0.03	<0,38 ± 0
YN	1950,41 ± 67,90	684,72 ± 8,92	540,58 ± 38,33	132,16 ± 16,36	5,26 ± 1,21	0,35 ± 0,018	<0,37 ± 0	<0,37 ± 0	<0,37 ± 0

YF: Yoghurt with the powder of Frezza date
YB: Yoghurt with the powder of Degla-Beida date
YM: Yoghurt with the powder of Mech-Degla date
YN: Yoghurt Nature

- The content of sodium YF is higher than YB, YM and YN. It is 959.36 (mg / kg) against 918.77, 783.37 and 684.72 (mg / kg) for YB, YM, YN respectively. The sodium content in the plain yoghurt is also variable: 311 mg / kg (Wang and Singh, 1978), 480 mg / kg (Souciet al, 1993) and 374 mg / kg (Garcia Martinez *et al*,1998). (Sanchez-Segarra *et al*, 2000) have found concentrations of sodium of 385 mg / kg for a strawberry yogurt, 356 mg / kg for a yogurt with blackberries, 392 mg / kg for a yogurt added to a mixture of fruits, 303 mg / kg for a normal peaches yoghurt; 385 mg / kg for a yoghurt with yellow peaches, 354 mg / kg for a yogurt with red Peaches and 357mg/Kg for the pineapple yogurt. The sodium content of our yoghurt is still double the values cited in the literature. It is in our view the only criterion of quality that may seem as apparent disadvantage of our formulations. However, as indicated in the following paragraph, this excess is largely compensated by a potassium deficiency.

- The potassium content of YM is higher with a value of 771.77 mg / kg. For a plain yogurt, this value is 2174mg/Kg (Wang and Singh, 1978) 1843 mg / kg and 1297 mg / kg (Moreno Rojas *et al*, 1993). (Sanchez-Segarra et al, 2000) have found potassium concentrations of 1191 mg / kg for a strawberry yogurt, 1209 mg / kg for a yogurt with blackberries, 1337 mg / kg for a yogurt added to a mixture of fruits, 921 mg / kg for a normal peaches yoghurt, 1119 mg / kg for a yogurt with yellow Peaches, 1135 mg / kg for a yogurt with red peaches, 1285mg/Kg for the pineapple yogurt. These figures are higher than those found in this study. As already mentioned, there is an advantageous compensation between sodium and potassium.

- On magnesium, its content is higher in the case of YB (267.85 mg / kg) is more than 10 times the values listed in the bibliography. (Sanchez-Segarra *et al*, 2000) have found concentrations of magnesium, 94 mg / kg for a strawberry yogurt, 101 mg / kg for a yoghurt with blackberries, 105mg/ kg for a yogurt added to a mixture of fruit, 82 mg / kg for a normal Peach yogurt, 84 mg / kg for a yoghurt with yellow Peaches, 86 mg / kg for a yogurt with red peaches, 97mg/Kg for the pineapple yoghurt.

-The content of Mg in the plain yoghurt varies between 80 and 131 mg / kg (Buttriss, 1997). These results are similar to ours in terms of plain yogurt.

- The content of iron in the three yoghurts (YM, YB, and YF) is almost identical and higher than YN: 9.6, 10.49, 11.52 and 5.26 mg / kg for YF, YB, YM and YN respectively. Moreover, these values are higher than those reported in the literature. It was indeed found that the amount of iron in the plain yogurt is 0.4 mg / kg (Pennington and Young, 1990), 0.47 mg / kg and 0. 5 mg / kg (Garcia Martinez *et al*, 1998), The yogurt is classified as a food of a less nutritional value because of its low contribution of iron in the diet value (Schneider, 1994) . The addition of fruit pieces, especially strawberries, raspberries and wild blackberries cause an increase in the concentration of all minerals (McCance et Widdowson, 1993).

(Sanchez-Segarra *et al*, 2000) have found concentrations of iron de1.18 mg / kg for a strawberry yogurt, 3.46 mg / kg for a yogurt with blackberries, 1.06 mg / kg for a yogurt added with a mixture of fruit, 0.45 mg / kg for a yoghurt with normal peaches, 0.86 mg / kg for a yogurt with yellow peaches, 0.62 mg / kg for a yogurt with red Peaches and 0, 78mg/Kg for the pineapple yogurt.

- Concerning the zinc, YF is richer than other yogurts. This content is equal to 7.93 mg / kg, while it is 2.74 (YB), 1.29 (YM) and 0.35 (YT). These results on the date's yoghurt are not consistent with the bibliographic data. (Fiszman *et al*, 1997) have found concentrations of zinc de 3. 2mg/Kg for a strawberry yogurt, 3.2 mg / kg for a yogurt with blackberries, 3.5 mg / kg for a yoghurt added to a mixture of fruit, 2.8 mg / kg for a yoghurt with normal peaches, 2.8 mg / kg for a yogurt with yellow peaches, 2.9 mg / kg for a yogurt with red peaches and 3.4 mg / Kg for the pineapple yogurt.

On the plain yogurt, the result is very low compared to data from the literature: 3.85-5.24 mg / kg (Buttriss, 1997), 5.5 mg / kg (Varo *et al*,1980), 4.6 mg / kg [11], 7 mg / kg and 3.5 mg / kg (Garcia Martinez *et al*, 1998).

-The concentration of manganese is 0.56 mg / kg for YF, 0.44 mg / kg for YB, 0.49 mg / kg for YM and less than 0.37 mg / kg for YN. These results (for the date's yoghurt) are consistent with those of literature: 0.041mg/Kg [19], 0.03 mg / kg, 0.061 mg / kg (Moreno Rojas *et al*, 1993) and 0.061 mg / kg (Garcia Martinez *et al*, 1998). The plain yogurt is considered as a food which is poor of Manganese (Garcia Martinez *et al*, 1998). The addition of pieces of strawberries and a mixture of fruit or blackberries increases the amount of Mn by 10-20 times and the addition of pineapple chunks between 40 and 80 times in the final composition of yoghurt.

- The contents of Pb and CD are almost identical in all the four yoghurts. They are less than 0.36 mg / kg. This prompts us to conclude that Pb and CD come mainly from the milk used. There are traces in date's fruit.

In all our results (except Na and K) are close to those found by (De La Fuente *et al*, 2003) in various market yoghurt. They reported values between 1547-2338l mg / kg for K, 476-777 mg / kg for Na, 101-177 mg / kg for Mg, 1088-2050 for Ca.

Conclusion: Large concentrations of minerals are found in all the three yoghurt-based on the powdered dates. We can say that the addition of powdered dates of the three cultivars (Mech-Degla, Degla-Beida and Frezza) in the yogurt as a substitute of granulated sugar, allows enriching yoghurt with minerals (Ca, Nas, K, Mg, Zn, in particular elements which are deficient in the milk: Fe and Mn).

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