

Comparative study between ingredients, nutritional composition and prices of greek and conventional yogurts commercialized in a nationwide supermarket chain in Brazil

Estudo comparativo entre ingredientes, composição nutricional e preços de iogurtes gregos e convencionais comercializados em um supermercado de rede nacional do Brasil

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Abstract

Objective: To compare the list of ingredients, nutritional composition and prices of Greek and conventional industrialized yogurts. *Methods:* A cross-sectional study was carried out in Dourados-MS, Brazil, through a census (February/2016) of yogurts available in an establishment belonging to the largest supermarket chain in Brazil. Data were collected from the list of ingredients, nutritional information table and price. Comparison was performed using Student's t-test, Mann-Whitney or Chi-Square test, with values expressed as average and standard deviation, median mean and interquartile range or prevalence, and 95% confidence interval, considering $p < 0.05$ as statistically significant difference. *Results:* A total of 117 yogurts were analyzed, of which 29.9% ($n=35$) were Greek, presenting higher amounts of ingredients, sugars and additives ($p < 0.05$). Although Greek yogurts have higher protein and calcium content ($p < 0.01$), they also have higher content of calories, carbohydrates, total and saturated fats, and sodium ($p < 0.01$). The price of Greek yogurt comes to be twice the price of the others ($p < 0.01$). *Conclusion:* The use of ingredients that artificially simulate desirable sensory and nutritional characteristics, such as higher viscosity and protein content, also gives the Greek yogurts commercialized in Brazil higher caloric content, as well as carbohydrate, total and saturated fat, and sodium content, when compared to the conventional ones. The higher price of this product does not correspond to a better nutritional value.

Keywords: Industrialized food. Nutritional information. Yogurt. List of ingredients. Nutrition labeling. Supermarket.

Resumo

Objetivo: Comparar as listas de ingredientes, a composição nutricional e os preços de iogurtes industrializados gregos e convencionais. *Métodos:* Estudo transversal realizado em Dourados-MS, por meio do censo (fevereiro/2016) de iogurtes disponíveis em estabelecimento pertencente à maior rede de supermercados do Brasil. Foram coletados dados da lista de ingredientes, tabela de informação nutricional e preço. A comparação foi realizada por meio do teste t Student, Mann-Whitney ou Qui-Quadrado, com valores expressos em média e desvio-padrão, mediana e intervalo interquartil ou prevalência e intervalo de confiança de 95%, sendo considerado $p < 0,05$ como diferença estatisticamente significativa. *Resultados:* Foram analisados 117 iogurtes, sendo 29,9% Course. Dourados, MS, Brazil. (n=35) gregos, os quais apresentaram maiores quantidades de ingredientes, açúcares e aditivos ($p < 0,05$). Embora os iogurtes gregos possuam maior teor proteico e de cálcio ($p < 0,01$), também possuem teores mais elevados de calorias, carboidratos, gorduras totais e saturadas e sódio ($p < 0,01$). O preço dos iogurtes gregos chega ao dobro dos demais ($p < 0,01$). *Conclusão:* O emprego de ingredientes que simulam artificialmente características sensoriais e nutricionais desejáveis, como maior viscosidade e teor proteico, também confere aos iogurtes gregos comercializados no Brasil maior teor calórico, teores de carboidratos, gorduras totais e saturadas e sódio, quando comparados aos convencionais. O maior preço desse produto não corresponde a um melhor valor nutricional.

Palavras-chave: Alimentos industrializados. Informação nutricional. Iogurte. Lista de ingredientes. Rotulagem nutricional. Supermercado.

Introduction

Greek yogurt, also known as concentrated yogurt or *Labneh*, originates in the Middle East and diffuses globally for its nutritional benefits. It is characterized by thicker consistency and more viscous body.^{1,2} It may contain higher values of proteins²⁻⁵ and viable microorganisms,³ and lower sodium² and lactose content,³ when compared to conventional yogurts.

The Greek yogurt sector has been growing rapidly. From 2011 to 2012, the sales volume of conventional yogurts fell by 10%, while the sales volume of Greek yogurts rose by 72% in the United States.^{6,7} This growth can be attributed to increased consumer concern about maintaining healthy eating habits, variability in sensory properties and manufacturing methods, lack of identity standards, and claims of nutritional superiority.^{2,3,7}

Traditionally, Greek yogurt is obtained from conventional yogurt by the desorption process in cloth bags.⁷ But, at the industrial level, this process can be slow and produce low yield. Thus, modern manufacturing processes include the use of centrifugation, recombination technology and ultrafiltration.³

Another method used to produce Greek yogurts is called “alternative process”. It consists of adding ingredients that reproduce their characteristics, eliminating the need for desorption, and making it possible to obtain products similar to those traditionally manufactured, at a lower cost.^{7,8}

Although the alternative process is more financially advantageous, the consumption of food additives is related to adverse reactions in humans, such as allergies, behavioral changes and carcinogenicity in the long run.⁹ In addition, the presence of large quantities of ingredients in yogurts, especially sugars and additives, classifies them as ultraprocessed products, i.e. a type of product whose consumption should be avoided in view of associations with chronic noncommunicable diseases.¹⁰⁻¹³

Thus, given the popularity of Greek yogurt and its perception as a healthy food, there is a need to verify if its nutritional composition is superior to that of conventional yogurt, and if there is an association with its selling price.

Methods

Cross-sectional and analytical study, carried out based on a census survey of the yogurts available in a supermarket in Dourados, the second largest city in Mato Grosso do Sul, whose population is estimated at 215 thousand inhabitants.¹⁴ The establishment was chosen because it belongs to the largest supermarket chain in Brazil,¹⁵ aiming to identify a variety of products that are possibly marketed elsewhere in the country.

The data collection was performed in February 2016, in a single day, to minimize possible changes in product disposition. The yogurts were identified from the sales denomination described on the labels, and the Greek ones were identified by the presence of the word “Greek”. Data collectors were previously trained.

For the data collection, a form elaborated from a model used in another study on nutritional labeling was considered.¹⁶ From the labels, information was collected regarding the list of

ingredients, nutritional composition per portion (energy value, carbohydrates, proteins, total and saturated fats, calcium and sodium) and unit price. The data collected were recorded in a *Microsoft Excel*® spreadsheet, with double entry, by different typists.

The type of yogurt (Greek or conventional) was considered as an independent variable, and the dependent variables were: (a) nutritional information and unit price; (b) number of ingredients, sugars and additives; (c) presence of the additives: acidulant, firming agent, flavoring, preservative, colorant, sweetener, thickener, stabilizer, acidity regulator. Although there are other functions of additives, only those mentioned were found in the yogurts of this study. Values of nutritional content and price were converted to 100g of product.

To verify the presence of additives, the list of ingredients was analyzed, and their functions were later identified.¹⁷

The Shapiro-Wilk test was used to verify the normality of the data distribution. The Mann-Whitney U test was used to compare nutritional composition and price. For the analysis of the list of ingredients, the Student *t* test, Mann-Whitney U test or Chi-square test was used. The value of $p < 0.05$ was considered statistically significant. For the analyzes, *Stata*® version 11.0 (*Statacorp*, College Station, TX, USA) was used.

Results

One hundred and seventeen (n=117) yogurts were found, of which 35 (29.9%) were Greek and 82 (70.1%) were conventional.

Greek yogurts presented higher amounts of ingredients, sugars and additives, when compared to the conventional ones ($p < 0.05$), according to Table 1.

Table 1. Number of ingredients, sugars and additives in conventional and Greek yogurts available in a supermarket belonging to a national chain, in Dourados-MS, February 2016.

Variables	Conventional Yogurt (n=82)		Greek Yogurt (n=35)		P value
	Average/Median	Mean SD/IQR	Average/Median	Mean SD/IQR	
Ingredients	15.5	12; 18	18.0	15; 20	<0.001*
Sugar	2.3	±1.2	2.8	±1.0	<0.05 +
Additives	6.2	±2.8	8.5	±2.4	<0.001 +

n=Number; SD=Standard Deviation; IQR=Interquartile Interval; * Mann-Whitney Test; +T Test.

As for the first three ingredients of the list, conventional yogurts presented whole milk, sugar and water (n=23, 28.1%) as main combination. Yet, the Greek ones presented protein concentrate from milk, skim milk and milk cream (n=9, 25.7%).

The analysis of the presence of sugar in the list of ingredients of conventional yogurts reveals that 84.1% (n=69) present two or more types of sugars, 6.1% (n=5) have one type of sugar, and only 9.8% (n=8) do not have sugar. All Greek yogurts presented sugars in their composition, with the majority (n=34; 97.1%) containing at least two types of sugars.

Most conventional yogurts (n=76, 92.7%) have additives and all Greek yogurts have additives (n=35, 100%). The most prevalent additive in the conventional yogurts was the preservative (n=71, 86.6%) and, in the Greek ones, the thickener (n=35, 100%).

The comparative analysis of the presence of additives by function between conventional and Greek yogurts shows that the Greek ones have more acidulant, thickener, stabilizer and acidity regulator ($p < 0.05$), as shown in Table 2.

As to nutritional composition, Greek yogurts presented significantly higher values in all analyzed variables ($p < 0.01$) (Table 3).

Table 2. Presence of food additives in conventional and Greek yogurts available in a supermarket belonging to a national chain, in Dourados-MS, February 2016.

Additives	Conventional Yogurt (n=82)			Greek Yogurt (n=35)			P value*
	N	Prevalence	IC 95%	N	Prevalence	IC 95%	
Acidulant	63	76.8	67.5; 86.1	34	97.1	91.3; 102.9	0.008
Firming agent	02	2.4	1.0; 5.8	01	2.9	-2.9; 8.6	0.896
Flavoring	69	84.1	76.1; 92.2	31	88.6	77.5; 99.7	0.534
Preservative	71	86.6	79.0; 94.1	33	94.3	86.2; 102.4	0.225
Colorant	60	73.2	63.4; 82.9	26	74.3	59.0; 89.5	0.900
Sweetener	13	15.8	7.8; 23.9	10	28.6	12.8; 44.3	0.113
Thickener	67	81.7	73.2; 90.2	35	100.0	100.0; 100.0	0.007
Stabilizer	42	51.2	40.2; 62.3	32	91.4	81.7; 101.2	<0.001
Acidity regulator	01	1.2	-1.2; 3.6	04	11.4	0.3; 22.5	0.012

n=Number; IC=Confidence Interval; *Chi-square Test.

Table 3. Content of energy, carbohydrates, proteins, total and saturated fats, sodium, calcium and price, in 100g of conventional and Greek yogurts; Dourados-MS, February 2016.

Variables	Conventional Yogurt (n=82)		Greek Yogurt (n=35)		P value*
	Median Mean	IQR	Median Mean	IQR	
Energy (Kcal)	93.2	74.1 - 101.5	124.4	80.0 - 149.0	<0.001
Carbohydrates (g)	14.4	7.1 - 15.5	16.0	11.0 - 18.0	0.009
Protein (g)	3.1	2.5 - 3.6	4.8	4.4 - 5.0	<0.001
Total fat (g)	2.5	1.3 - 3.1	4.8	1.9 - 6.1	<0.001
Saturated fat (g)	1.7	0.8 - 2.0	3.0	1.3 - 4.0	<0.001
Sodium (mg)	47.9	39.0 - 56.7	64.4	41.0 - 67.8	<0.001
Calcium (mg)	114.8	95.2 - 141.2	150.0	140.0 - 173.0	<0.001
Price (Reais)	0.97	0.88 - 1.26	1.99	1.56 - 2.55	<0.001

n=Number; IQR=Interquartile Interval; * Mann-Whitney Test.

Discussion

Since the introduction of Greek yogurt on the market, sales have increased exponentially.⁶ It is estimated that, over five years, Greek yogurts have gone from 1% to 36% of all yogurts available in supermarkets in the United States.¹⁸ In Brazil, this trend seems to be repeated, since the availability of Greek yogurts reached almost 30% of the total yogurt available in the selected supermarket.

Both types of yogurt presented an extensive list of ingredients, of which approximately half are additives, classifying them as ultraprocessed products. Ultraprocessed products are often nutritionally unbalanced and their high consumption is associated with obesity, cardiovascular diseases, diabetes, nutritional deficiencies and some types of cancer.¹⁰⁻¹³

It is believed that the frequent presence of acidifying, thickening, stabilizing and acid-regulating additives in Greek yogurt derives from the alternative production process, whose addition is used to simulate desirable sensory characteristics.^{7,8} The implications of the consumption of food additives and their risks to human health range from allergic reactions to neoplasia.^{9,19} Consumption by individuals sensitive to thickeners, used in all Greek yogurts present in this study, can lead to anaphylactic shock, chronic urticaria and contact dermatitis.²⁰

According to the Brazilian legislation, neither type of yogurt can be considered of low energy value,²¹ but the Greek ones have shown to be more caloric. This feature is worrying since when a food is advertised as healthy, consumers tend to overeat it and underestimate its calorie intake,^{22,23} increasing the risk of weight gain.²⁴

The excess of free sugars can also increase the risk of weight gain, dental caries and other chronic diseases.^{10,24} In Brazil, it is not mandatory to state the quantity of sugars in nutritional labeling,²⁵ which makes it impossible to quantify the sugar content in the yogurts present in this study. However, by analyzing the list of ingredients, it is noted that Greek yogurts have a higher presence of sugars.

The carbohydrate content of Greek yogurts has also been higher, and it is believed that this characteristic is due to the high presence of sugar and the addition of ingredients such as starch, to thicken the product body. The fact that Greek yogurt has a higher protein content when compared to the conventional one was already expected, corroborating other studies, consumer expectations^{3,7,10} and international standard requirements.²⁶ This characteristic seems to be the result of the addition of protein concentrates in the alternative process, an ingredient present among the top of the list of most Greek yogurts.

High protein values usually promote satiety.²⁷ However, the values found in Greek yogurts in this study may be insufficient to cause this improvement, as they are lower than the values reported in studies carried out in other countries, which may be up to five times higher,^{4,5} and are insufficient to classify Greek yogurts as protein sources.²¹

Greek yogurts have almost twice the total fat and saturated fat content of conventional yogurts. However, these figures may be even higher in other countries.³ Milk cream is among the first ingredients of most Greek yogurts, probably in order to thicken the product body, which should lead to increased fat. It is known that excessive consumption of total and saturated fats increases morbidity and mortality by cardiovascular diseases.^{10,24}

It can be considered that both types of yogurt have low sodium content,²¹ but the Greek one presents higher values, contrary to the literature.² This is a worrying feature since the excessive consumption of this micronutrient is related to the risk of cardiovascular diseases.²⁴ Possibly this finding stems from the addition of food additives, such as sodium cyclamate and sodium citrate.

A positive aspect of Greek yogurts is that they can be considered a source of calcium,²¹ unlike the conventional ones. This is an essential mineral which plays a vital role in neuromuscular function, enzymatic processes, blood clotting and bone rigidity,²⁸ and seems to have specific mechanisms of appetite control.^{29,30}

Greek yogurts were also more expensive, at twice the price of the conventional ones, corroborating other findings.⁶ In Brazil, most of these yogurts are produced through alternative process.⁸ Thus, this price difference is believed to be due to food industry speculation about consumers' expectations of the benefits of Greek yogurts. In consumer perception, the potential benefits seem to justify their higher cost.⁹

In the Technical Regulation of the Identity and Quality of Fermented Milks,³¹ the legislation does not describe, define or even cite Greek yogurt. Thus, food industry is free to use this denomination, regardless of the form of production or composition.

The importance of standardizing terminologies on industrialized food labels is reinforced, which should be publicized in a way that allows the consumer to make a fair and informed choice. In addition, it is not appropriate for any *marketing* term to be used, unless the meaning is clear.³² In view of this, it is questioned whether the consumer's right to adequate, clear and concise information is guaranteed when there is the use of "Greek" terminology in yogurts.

Conclusion

In Brazil, Greek and conventional yogurts present different compositions resulting from the alternative manufacturing process, which employs ingredients that artificially simulate desirable sensory and nutritional characteristics, such as higher viscosity and protein content. This same process gives a higher caloric content to the yogurts, in addition to carbohydrate, total and saturated fats, and sodium content, mischaracterizing them when compared to the Greek yogurt marketed in other countries.

It is likely that the higher price of Greek yogurts is due to *marketing* strategies that attribute market value to consumers, although they do not correspond to nutritional superiority.

There is a lack of studies on Greek yogurt, which indicates the relevance of contributing to this theoretical gap. It is clear the need to standardize the criteria for the use of this terminology, and it is suggested to establish a standard of identity and quality for Greek yogurts.

Contributors

Benatti VM worked on collecting and tabulating data, and preparing the article; Ramalho DBF worked on tabulating data and preparing the article; Moreira CC worked on the conception and designing of the study, analyzing the data, reviewing and approving the final version of the article.

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