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Profile of publications about functional foods in Brazilian journals: a scientometric analysis from 2000 to 2015 and an overview of Brazilian legislation

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ABSTRACT. Functional foods have been highlighted by having, in addition to nutritional characteristics, the possibility of preventing risk and/or delaying the development of several non-communicable diseases (NCDs). In the last decade, many articles related to functional food have been published worldwide, and there is a need to understand how the theme is reflected in national journals. The present research aimed to collect information about publications covering the topic of functional foods in journals, synthesizing these data and interpreting them, evaluating the profile of the authors and a frequency of the articles involved with the subject by scientific journal and by State/region. Subsequently, they were evaluated as the most studied foods and as more used methodologies, besides a small discussion about the advances of the Brazilian legislation on the subject. Between 2000 and 2015, 118 articles were selected in 62 educational institutions from 18 Brazilian states. The South (44%) and Southeast (34%) regions were the ones that published more, having Rio Grande do Sul the largest representation (24%). The journal with the largest publication was Food and Nutrition and the authors' academic formation was diverse (29 areas in total), in particular Food Technology (21%), Nutrition (18%) and Food Engineering (13%). The Brazilian legislation is in development and has a good perspective to include new foods/ingredients with functional property.

Keywords: information gathering, functional property request, Brazilian publications, Anvisa.

Perfil de publicações sobre alimentos funcionais em revistas brasileiras: uma análise cienciométrica de 2000 a 2015 e uma visão geral da legislação brasileira

RESUMO. Os alimentos funcionais destacam-se por possuírem, além de características nutricionais, a possibilidade de reduzirem o risco e/ou retardar o desenvolvimento de várias doenças não transmissíveis. Na última década, muitos artigos relacionados às propriedades funcionais de alimentos têm sido publicados mundialmente, havendo a necessidade de entender como o tema se reflete nos periódicos nacionais. O presente trabalho procurou coletar informações sobre as publicações, abrangendo o tema alimentos funcionais em periódicos nacionais, sintetizando esses dados e interpretando-os, avaliando o perfil dos autores e a frequência dos artigos envolvidos com o tema por revista científica e por Estado/região. Posteriormente, foram determinados quais os alimentos mais estudados e quais as metodologias mais empregadas, além de ter sido realizada uma pequena discussão sobre os avanços da legislação brasileira sobre o tema. Entre os anos 2000 e 2015 foram selecionados 118 artigos, em 62 instituições de ensino de 18 Estados brasileiros. As regiões sul (44%) e sudeste (34%) foram as que mais publicaram, tendo o Rio Grande do Sul a maior representação (24%). A revista com maior publicação foi a Alimentos e Nutrição e a formação dos autores era diversa (29 áreas no total), em especial Tecnologia de Alimentos (21%), Nutrição (18%) e Engenharia de Alimentos (13%).

Palavras-chave: coleta de informação, alegação de propriedade funcional, publicações brasileiras, Anvisa.

Introduction

The low occurrence of certain diseases, such as heart disease, breast cancer and coronary disease are evidenced by epidemiological data and it is observed in many countries. These data caused interest in how the food of these peoples was based, being observed in their feeding the consumption of omega 3 and omega 6 in countries that consume fish, of red

wine or soy, phytoestrogens-rich compounds that may reduce the risk of breast cancer, or fruits and vegetables, which also have functional potential. Each food, with its nutrient and non-nutrient characteristics, has the possibility of reducing the development risk of specific diseases (Hasler, 2002, Anjo, 2004, Bech-Larsen & Scholderer, 2007). The increase in the incidence of chronic non-communicable diseases (NCDs) is not only related to the increase of life expectancy, but also to the habits of the population's life. For example, childhood obesity and the growth in the incidence of type 2 diabetes in young adults are not the only factors related to the increase in life expectancy (Vidal et al., 2012).

The concept of functional food was introduced by the Japanese government in 1980. Foods were already marketed and it was decided to regulate them due to the growing demand, as a consequence of the high competition in the market, the increase in the population life expectancy, the technological innovations, as well as the bioactivity of some food compounds and a greater interest of consumers by this type of diet (Milner, 1999, Martins, Pinho, & Ferreira, 2004, Bech-Larsen & Scholderer, 2007).

In addition to their nutritional value, the functional foods also have metabolic and physiological effects that aid in the prevention and treatment of diseases. Its influence has been perceived in pathologies such as cancer, diabetes, hypertension, Alzheimer's disease, bone, cardiovascular, inflammatory and intestinal diseases. Therefore, attention should be paid to the adoption of dietary patterns with a high amount of fats and sugars, increasing the risk of cardiovascular disease. In this sense, Brazilians began to worry about their eating habits and started looking for a balanced diet, if possible linked to foods that can help and/or prevent the pathologies mentioned above (Roberfroid, 2000, 2002, Vidal et al., 2012).

As a supportive and promotion environment is being formed by the communication media in response to the significant advances in food research and development, these changes are leading to a greater acceptance of industrialized functional foods, resulting in a more accessible global market and in a significant growth in international business, helping to expand the food industry. Consequently, these foods have becoming important to a several countries economy, helping market competition and therefore requiring further studies and the creation of standards that can regulate the industrialized products with such characteristics (Basu, Thomas, & Acharya, 2007, Bech-Larsen & Scholderer, 2007).

For science progress, the collection and organization of available information are essential, as well as a better explanation and/or development of reliable collection methods that guide future work in a certain direction (Wolf, 1986, Figueiredo Filho, Paranhos, Silva Junior, Rocha, & Alves, 2014). Functional foods have been used as marketing in the last decades due to increased concern between food/nutrition and the health maintenance (Lopez-Varela, Gonzalez-Gross, & Marcos, 2002, Siró, Kápolna, Kápolna, & Lugasi, 2008, Bandyopadhyay & Mandal, 2014). Brazil has published in national journals a modest but not small number of articles related to the theme, and an outlook about how the national journals are reflecting the theme can help to understand aspects about dissemination and distribution of information by these media inside the country.

In this sense, the present study aimed to collect information on publications covering the topic of functional foods present in national journals (with most authors and national institutions), synthesizing these data, evaluating the authors' profile and the frequency of the articles involved with the subject by scientific journal and by State/region, and also determining the foods most studied and the methodologies most used.

Material and methods

Data from the present study consisted of articles published in national journals, available from the Capes (*Coordenação de Aperfeiçoamento de Pessoal de Nível Superior*) Portal. The inclusion of publications on functional foods was defined based on the analysis of the titles, abstracts and keywords that contained or were characterized with the theme 'functional foods', 'functional food', 'nutraceutical foods' and 'nutraceutical food' in articles published in national journals. For the research safety, Brazilian journals were also consulted in the area of Food Science and Technology, qualified with high *Qualis* Capes and/or large circulation, within the national standard, to mention Brazilian Journal of Food Technology, Food Science and Technology, Boletim Ceppa, Revista Brasileira de Nutrição, Revista Brasileira de Produtos Agroindustriais, Ciência Rural, Brazilian Journal of Food and Nutrition and Higiene Alimentar.

For the analysis, only review articles and original articles were used. The technique used was the quantitative analysis suggested by Figueiredo Filho et al. (2014), being characterized in the first moment

as an exploratory (quantitative) study and, in a second moment, assuming a descriptive characteristic. It is important to emphasize that the articles focus was not always entirely on functional foods, although the product under study had functional characteristics and, therefore, were not excluded from this study trial.

The second step was to classify the articles based on the following topics:

1. Sampling characterization - HEI (Higher Education Institution) and area of academic formation of the authors;
2. Brazilian journals;
3. Research type;
4. Main methodologies used in the functional foods study;
5. Main foods cited and aspects of Brazilian legislation.

Then, the results were quantified with the simple frequency counting and other practices used by Figueiredo Filho et al. (2014). The software Microsoft Excel and Statistica 8.0 were used for the descriptive analysis, being the results presented in tables and graphs.

Results and discussion

A total of 118 articles were quantified between 2000 and 2015, distributed in 33 journals with different *Qualis* Capes. Several areas were mentioned, the main ones being related to Food Technology, Nutrition, Food Engineering, Pharmacy, Chemistry and Agronomy. It is worth noting that there was also comprehensiveness in other areas, such as Phytotechnology and Chemical Engineering, but in a lower frequency.

Sampling characterization

Distributed from 2000 to 2015, the articles collected presented, at the beginning, a low frequency, having until 2007 only 20% of the articles found published. After this, there was a significant increase, with almost 80% of the publications related to the theme (Figure 1). This may be a result of changes in Brazilian legislation on the subject, publishing ordinances, resolutions, normative and technical instructions, divulging to the industry the importance of delimiting foods with these properties, mainly from the year of 1999, because the first legislation was in this year.

Most of the authors have affiliation in Federal and State Universities, in different Brazilian regions, totaling 62 Teaching Institutions in 18 different states. The publications frequencies, divided by region, are described in Figure 2a. The South (43%) and Southeast (34%) regions had hegemony in the scientific production published in national journals on functional foods, followed by the Northeast region (14%) and, to a lesser extent, North and Midwest, which together added up 7% of publications.

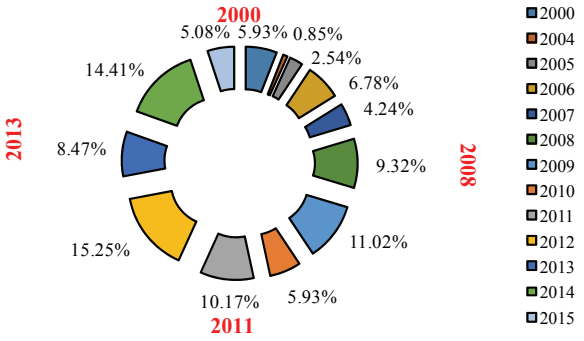

Figure 1. Frequency of articles publications per year within the theme of functional foods.

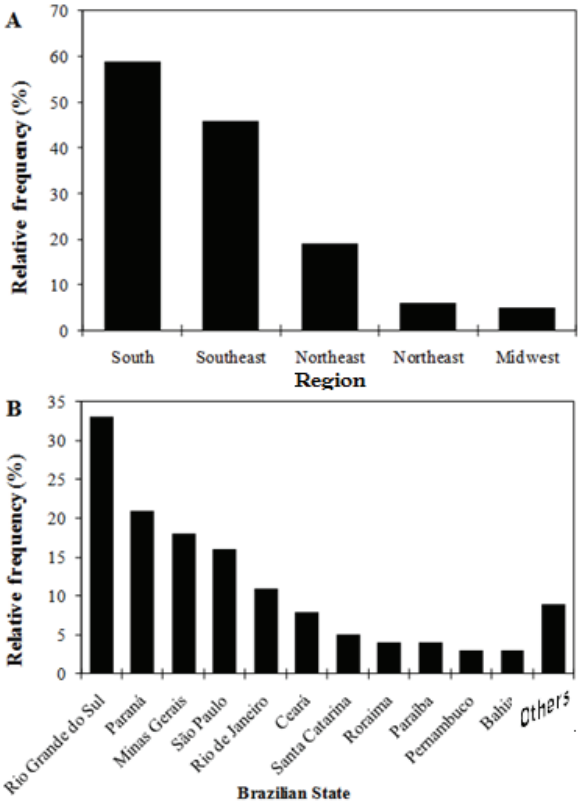

Figure 2. Distribution of articles by region of the country and Brazilian states.

Due to climatic diversity, vast biome and continental dimensions, all Brazilian regions have food resources with probable functional properties. Thus, develop studies on the use of these regional products and in the development of new foods from them would not only help in the publications

distribution and comprehensiveness of knowledge, but also in the development of exotic products in all regions, with immense scientific and technological gains for the country.

Figure 2b shows the States with the highest frequency of publications, where the Southeast region stands out. The Northeast was better represented by Ceará and Paraíba. From the North and Midwest regions, Roraima reached a prominent place, although the participation of these regions in comparison with the others was much lower.

Amazon, with one of the greatest biodiversity on the planet, accumulates an immense amount of regional products (Alencar, Yuyama, Varejão, & Marinho, 2007). It has a large collection of typical fish and fruits, which can represent a significant supply of proteins, calories, vitamins and minerals, providing a great supply of nutrition and health standard for its consumers (Clay, Sampaio, & Clement, 2000). Due to these factors, it would be really interesting to have a greater commitment to functional food research in the North region, gathering information about its regional products.

From the 62 educational institutions, it was possible to relate those that had a higher frequency of published articles with the typologies of food studied in each one (Table 1). The most expressive universities in national scientific production on functional foods were the *Universidade Estadual de Londrina* (UEL), *Universidade Estadual de Campinas* (Unicamp), *Universidade Federal de Santa Maria* UFSM), *Universidade Federal do Ceará* (UFC), *Universidade de São Paulo* (USP) and *Universidade Federal de Pelotas* (UFPel), traditional Brazilian institutions.

The main foods published in the Brazilian journals by these institutions, also detailed in Table 1, were evaluated and compared with the Brazilian legislation for functional foods. Foods of animal and plant origin, as well as nutrient and non-nutrient components were mentioned, and a diversity of studies on the subject was verified.

The main areas of academic formation of the authors were Food Technology (21%), Nutrition (18%) and Food Engineering (18%), which together consisted of more than 50% of the areas cited. It was also mentioned Agronomy, Chemistry, Pharmacy, Phytotechnology, Food Science, Industrial Chemistry and Chemical Engineering (Figure 3).

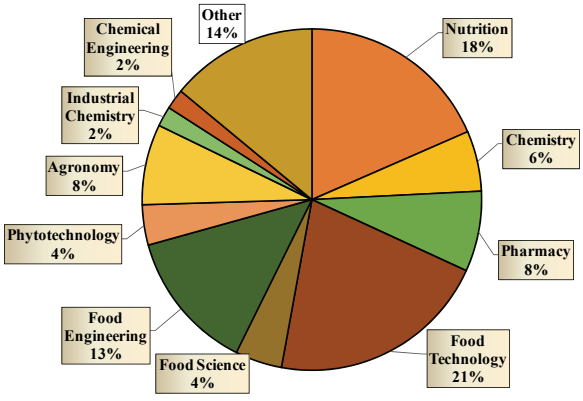

Figure 3. Main areas of authors' formation.

Table 1. Publications by educational institution.

Teaching Institutions	Published Articles	Food, Nutrient and Non-nutrient
Universidade Estadual de Londrina	11	Degreased soybean meal, oat bran, *Lactobacillus casei* (LC-1), *Lactobacillus paracasei*, amaranth, blueberry bagasse, soybean, starch, milk and inulin
Universidade Estadual de Campinas	8	Soy extracts, rice extracts, cashew nuts, sodium chloride, buttermilk, soy protein isolate, green banana flour, β-galactosidase and lycopene
Universidade Federal de Santa Maria	8	Anchoice, Yacon potatoes, barley, pork, apple bagasse flour, orange-pomace flour, passion fruit bark, blueberry bagasse, beans and goat's milk
Universidade Federal do Ceará	7	Soy flour, linseed flour, refined organic sugar, brown sugar, milk chocolate, guava seed powder and jabuticaba peel
Universidade de São Paulo	7	Soybean, green banana flour, jabuticaba, cassava, acerola, sweet lupins, pigeon peas and ham
Universidade Federal de Pelotas	7	Soya extract, rice extract, *Lactobacillus paracasei*, inulin, green banana flour and yerba mate
Universidade Federal do Rio Grande	5	Anchoice, chitosan, chia and pink shrimp
Universidade Federal de Roraima	4	Fruits native to the Amazon region, açaí and bacaba
Universidade Federal de Santa Catarina	4	Chitosan, redcurrant, fermented milk, apple and inulin
Universidade de Passo Fundo	2	Cultivars of strawberry
Universidade Federal do Rio Grande do Sul	2	Bibliographical reviews that include functional foods in general
Universidade Federal de Viçosa	3	Lutein and genipap
Universidade Federal de Minas Gerais	2	Peel of passion fruit and inulin
Universidade Federal de Lavras	3	Seeds of pumpkin, strawberry and soy
Universidade Federal da Paraiba	3	Munguba, taro starch and watermelon
Universidade Federal do Paraná	3	Banana, yerba mate, passion fruit and soy protein
Universidade Federal do Rio Grande	2	Pink shrimp and chitosan
Univates	2	Cheese whey
Universidade Federal de Goiás	2	Plant residues and rice flour
Universidade Federal Rural do Rio de Janeiro	3	Beverage of soybeans and acerola, soy milk, fermented milk and honey of assa-fish (*Vernonia scabra*)
Universidade Estadual de Ponta Grossa	3	Dehydrated refined pulp of apple, cassava, passion fruit and soy protein
Universidade Federal Rural de Pernambuco	2	Flakes of pumpkin and carambola pulp

The first three areas mentioned above add up to the conception of a safe food with food characteristics in accordance to current legislation. Food Technology is a multidisciplinary area that uses the areas of chemistry, biochemistry, nutrition, pharmacy, among others to promote management techniques and technological changes that improve the conditions of safety, quality, health and respect for the environment. Applied to the food area, Nutrition is concerned with the promotion/recovery/maintenance of a healthy life through the use of a balanced diet. Food Engineering deals with the study and application of unitary and fermentation techniques for the design, storage and food transportation. The interaction between the three areas is important, where Food Engineering promotes the production process, Food Technology takes care of the management and application of appropriate techniques, and Nutrition evaluates the nutritional quality of this food, having greater representativeness of formation in the published articles.

Brazilian journals

The main Brazilian journals utilized to publish the articles were Ciência e Tecnologia de Alimentos (Campinas - São Paulo), Revista Brasileira de Fruticultura (Jaboticabal - São Paulo) and Alimentos e Nutrição (Araraquara-São Paulo), with more than 50% of the publications (Figure 4). Other journals, less cited, but with a good percentage were the Brazilian Journal of Food Technology (Campinas - São Paulo), Boletim do Centro de Pesquisa e Processamento de Alimentos (B. Ceppa) (Curitiba-Paraná) and Ciência Rural (Santa Maria-Rio Grande do Sul).

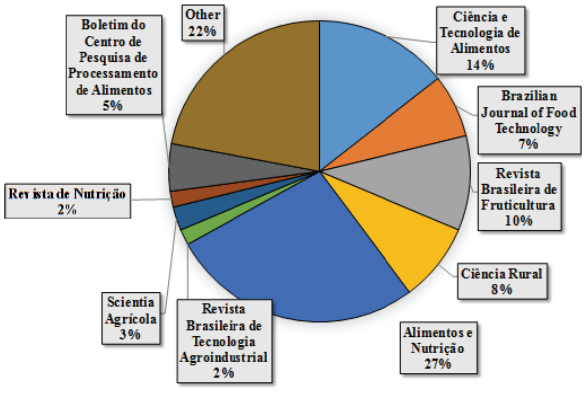

Figure 4. Main journals used for publication on functional foods.

An important parameter is the articles classification in the *Qualis* Capes, based on the journals where they are published. The journals classification is made by each evaluation area, updated annually. The classification has a quality range between A1, highest, A2, B1, B2, B3, B4, B5 and C, the latter with zero weight. This range is used in Brazil by Capes for the evaluation and classification of the postgraduate courses, being any other type of use outside its responsibility. This type of division does not directly reflect the quality of the published article, but rather the prestige of the journal for that particular area evaluated (Engineering II, Food Science, Nutrition, etc.). Therefore, a high quality research is advised to publish in these journals, reaching a wider scientific scope for their area of study. In the analysis carried out in this article, 67% of papers were published in periodicals with *Qualis* in the area of Food Science and Technology, with the majority characterized by *Qualis* C, not very significant in terms of evaluation. For the Nutrition area, only 32% were evaluated by *Qualis*, mostly between B2 and B4, which represents a reasonable percentage (Figure 5a).

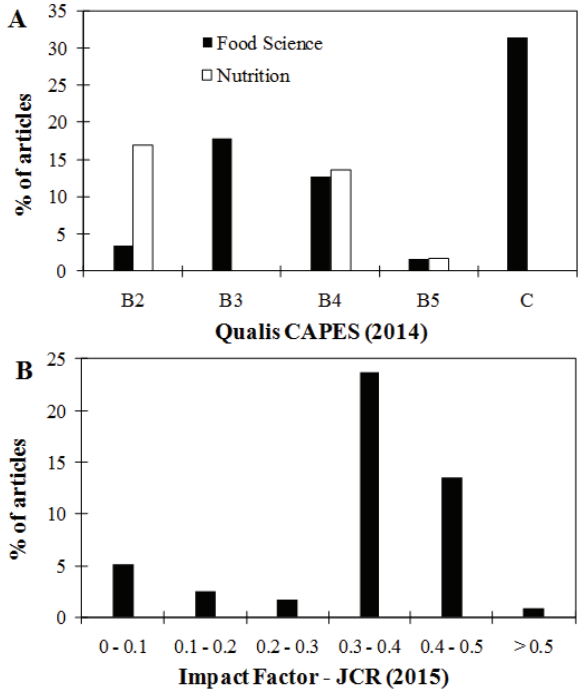

Figure 5. Publications by *Qualis* Capes and JCR impact factor.

The Impact Factor (JCR) and the Scopus indexed database are the most widely used and comprehensive classification criteria for collecting citations and grouping high impact articles. The survey indicated 48% of articles published in journals with impact factor between 0 and 0.6 (Figure 5b), with most publications between 0.3 and 0.5. Within the national standard, that is, of the

impact factors exhibited by the most respected national journals, generally being between 0 and 1.2, these values are considered reasonable.

Research type

In scientific circles, experimental research is the one with the most prestige. In it an analysis of an object of study is made, being able to manipulate the variables, to control and to observe the effects. Bibliographical research, in turn, is carried out with analyzes of already elaborated materials, such as books and scientific articles, being also the principle of other types of researches. Documentary research is very close to bibliographic research, differentiating itself by the material basis that, in this case, are materials that have not yet been organized so as to have perceptions to contribute to the research object, as in the case of resolutions and laws (Gil, 2002).

The research showed that in 75.2% of the analyzed articles the experimental research was the method used, which is positive due to the importance that is given to this type of research in the scientific environment. Less frequently, documentary research (6.4%) and bibliographic research (18.4%) were used in the evaluation of functional foods.

Main methodologies used in the functional foods study

Bromatology, a science that seeks to study food, determines the composition of food before and after the various processes to which it can be subjected in the food supply chain (fresh, processed, enriched or modified). This occurs by analyzing the various aspects related to food, such as physicochemical, microbiological, biochemical, rheological, sensory, marketing, among others.

The research noticed that almost 50.6% of the work is still related only to the physicochemical analysis of food, determining the components of the fresh and processed food. In sequence, with 25.6% is the study of sensory aspects, science of extreme importance for the technological application of food, based on the senses of the human body (smell, touch, sight, taste and hearing), that determine the acceptability and satisfaction of a food by consumers. Articles in questionnaires form have been found (18%) and are important, as they try to verify behaviors, needs, preferences and the psychosocial status of the interviewees on a given topic, and it may be noted that marketing and promotion needs of specific foods/foods (food characteristics and the best way to represent them) are poorly understood and/or used in new products entering the market.

For Food Technology, rheological behavior is important (5.8%), although it is studied to a minimal extent in published articles. Rheology, in general terms, seeks to delimit the study of food deformation and flow, being fundamental for the technological aspects and the development of equipment, besides having relation with the sensorial characters and, as a result, to food acceptance. One aspect for this, probably, is the high equipment cost to perform these analyzes that preclude its use in the papers.

Main food cited and aspects of Brazilian legislation

The foods studied during these years, in the theme of functional foods, were diverse, many of them in the form of flour, fresh or added with some complementation. One of the first definitions in national legislation, if not the first one, was carried out by Ordinance n° 398 of 04/30/99, of the Brazilian Health Regulatory Agency (Anvisa): 'Any food or ingredient that, in addition to the basic nutritional functions, when consumed as part of the usual diet, produces metabolic and/or physiological effects and/or beneficial effects on health and should be safe for consumption without medical supervision'.

Another necessary explanation is that functional food is not the same as nutraceutical, since the former, in addition to health effects, is similar to conventional food, being administered in a normal diet and without medical supervision, whereas nutraceuticals are administered as a food/medicine in amounts normally greater than the ingested in normal foods, such as omega 3 and carotenoid capsules.

These definitions are complex and change according to the organ and the region of the planet, which in many cases do not define functional foods individually, associating them with specific functional claims, as is the case of Anvisa. It does not use the defined concept of functional food, but two categories: 'Allegation of Functional Property', relative to the metabolic/physiological function that the nutrient in question represents for the growth, development and maintenance of the vital functions of man and 'Allegation of Health Property', which states, suggests, or relates a link between the nutrient/ingredient with a disease or any condition related to the human health.

In the Brazilian legislations many details can be found regarding what is or is not allowed during the marketing and mandatory information on food labels with functional property claim, as well as the list of new ingredients and foods which are updated as much as possible and should be constantly

reviewed, in addition to the fact that there are more specific legislations for each type of product.

An important concept defined by Anvisa is 'new foods and/or new ingredients', foods or substances with no history of consumption in the country, or foods with substances already consumed that may be added at levels much higher than those currently observed in the regular diet. Foods that are to be consumed in capsules, tablets or other pharmaceutical forms and which do not present a claim of scientifically proven functional or health properties should bear the label 'The Ministry of Health warns: There is no scientific evidence that this food prevent, treat or cure diseases' (Stringheta et al., 2007).

Agência Nacional de Vigilância Sanitária (Anvisa, 2008) recognizes as functional property products fatty acids, carotenoids, food fibers, phytosterols, soy protein, chitosan, polyols (mannitol, xylitol, sorbitol) and probiotics (*Lactobacillus acidophilus*, *casei Shirota*, *casei* variety *rhamnosus*, *casei* variety *defensis*, *paracasei*, *lactis*, *Bifidobacterium bifidum*, *animallis* (including the subspecie *B. lactis*), *longum*, and *Enterococcus faecium*). It is important to emphasize that the permission for entry a food with functional property claims/bioactive substances into the market compete to Anvisa (represented in large part by CTCAF - Scientific and Technical Advisory Committee on Functional Foods and Novel Foods) and requires a previous evaluation of a technical-scientific report submitted by the company/institution concerned (A list of the main Brazilian documents and the definitions of these products cited above are discussed in http://portal.anvisa.gov.br/alimentos/alegacoes and available in Appendix A).

In articles that study specific foods, foods rich in fiber (fibers and prebiotics) and proteins are the most studied, covering more than half of published articles. Within these categories, foods were also shown to be rich in vitamins, minerals and, in some cases, in omega 3, such as oil meal and pumpkin seeds. Soybean was the most cited food in the articles, both in the form of extracts, as well as flours and soy milk (Table 2). Dietary fiber is the fiber resistant to the action of human digestive enzymes, consisting of carbohydrate polymers, with three or more monomeric units, and lignin (Anderson et al., 2009, Howlett et al., 2010, Bernaud & Rodrigues, 2013).

The soluble fibers (pectins, gums, inulin and some hemicelluloses) dissolve in water, forming viscous gels, not being digested in the small intestine and easily fermented by the micro flora of the large intestine. Insoluble fibers (lignin and cellulose), on the other hand, are not soluble in water and their fermentation is limited (Wong & Jenkins, 2007). The main effects of fiber use are correlated with the shrinkage of blood cholesterol and reduced risk of cancer, acting in the following processes: (1) ability to retain toxic substances (ingested or formed in the digestive tract); (2) decrease of intestinal transit with reduction of the possibility of adversities due to the high contact between the fecal cake and the tissues of the treatment; and (3) formation of protective compounds from probiotic microorganisms (Anjo, 2004).

Table 2. Main foods studied.

Food Type	Frequency	Source
Fiber	37%	Soybeans, greens, inulin, green banana, linseed meal, chia, yacon potato, açaí, passion fruit peel, pumpkin seed, cassava and jabuticaba
Prebiotics	14%	Dairy drinks, Yacon flour and modified starch
Probiotics	10%	*Lactobacillus paracasei*, dairy drinks and fermented milk
Antioxidants	12%	Vegetables, garlic, Yacon potato, chia, barley, cashew nuts and strawberries
Proteins	27%	Soy extract, rice extract, cashew nuts, cassava, pumpkin seeds, chia, soy milk, whey, açaí and whey cheese

Prebiotic can be defined as a non-digestible food ingredient, fermented in the human intestine, which beneficially affects the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon, increasing host health (Siró et al., 2008, Bandyopadhyay & Mandal, 2014). As examples, are mentioned inulin of frutoligosaccharides (FOS) and pectin, assisting intestinal transit and protecting against infections, besides support the nutrients absorption (Lopez-Varela et al., 2002).

Probiotics are living microorganisms present in the human intestinal tract, which act in a protective and preventive infections form, being LAB (Latic acid bacteria and bifidobacteria) the most studied (Siró et al., 2008).

In relation to antioxidants, the cells of our body can be damaged by the action of free radicals, being these substances able to prevent and/or reduce such damages, interfering directly in free radicals or indirectly by the action of enzymes in the human body. A balanced diet in fruits and vegetables, and many other foods that have antioxidants, such as vitamin C, uric acid and vitamin E, are important to prevent the damage that free radicals can cause (Shami & Moreira, 2004).

Proteins, composed by amino acids, are essential for a proper functioning of the body and are of great importance in a balanced diet. Among the amino acids with functional property claims, tryptophan, tyamine, arginine, glutamine and cysteine are cited, related to processes of sleep regulation and stress

control, assisting in various aspects of the nervous and immune system (Lopez-Varela et al., 2002).

From the nationally published articles and analysis of the current legislation, it was noticed that Brazil is progressing in relation to the functional properties of food, despite the small amount of food/compounds characterized as functional property holders. It is hoped that information on the subject will be further worked out in the coming years, as the development of such food will increase, with more homogeneous regional dissemination and greater emphasis on native products.

Conclusion

Over the years there has been a considerable increase of published articles on the topic of functional foods in national journals, probably due to the advancement of technologies and the recognition of Brazilian bodies on the subject, with the publication of technical and normative instructions, resolutions and ordinances, allowing, over time, easy access to information in relation to the importance of qualifying a food as functional. The Higher Education Institutions of the South and Southeast regions were the most cited in the publications, as well as the publishing medium (journals), indicating a need for development of the North/Northeast region on the theme. The diversity in the type of food and nutrients/non-nutrients compounds studied was shown, with predominance of proteins and fibers, totaling more than 50% of the articles published in this topic. These publications tend to grow because they have seen many foods with potential for industry.

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Appendix A

Supplementary information. Revised version on April, 2017.

Main Brazilian documents and definitions of foods/products

The main legislation and information of the Brazilian bodies, linked to Anvisa, on the subject are:

Resolution n° 18, of 04/30/1999 (republished from 12/03/1999): approves the technical regulation that establishes the Brazilian Regulation and the Legislation for functional foods. 12/03/1999: approves the technical regulation that establishes the basic guidelines for the analysis and verification of functional and/or health properties alleged in food labeling. Retrieved from http://www.anvisa.gov.br/legis/resol/18_99.htm

Resolution n° 19, de 04/30/1999 (republished in 12/10/1999): approves the technical regulation of procedures for registration of food with claim of functional properties and/or health in its labeling. Retrieved from http://portal.anvisa.gov.br/documents/33916/394219/RESOLUCAO_19_1999.pdf/f33ae19c-1f69-4994-8fb3-82fd5b8024b9

Technical Report nº 9 of 21/05/2004. Guidance for the use in food labels of functional properties of nutrients. Retrieved from http://www.anvisa.gov.br/alimentos/informes/09_210504.htm

Foods with claims of functional and/or health properties, new foods/ingredients, bioactive substances and probiotics. 2005-2009. Retrieved from http://www.anvisa.gov.br/alimentos/comissoes/tecno.htm

Guide to the food safety verification and ingredients. 2013. Retrieved from http://portal.anvisa.gov.br/documents/33916/395734/Guia+para+Comprova%C3%A7%C3%A3o+da+Seguran%C3%A7a+de+Alimentos+e+Ingredientes/f3429948-03db-4c02-ae9c-ee60a593ad9c

Anvisa, through the list of claims with functional property (updated July 2008 - http://www.anvisa.gov.br/alimentos/comissoes/tecno_lista_alega.htm) recognizes up to the moment, the following allegations:

Fatty acids: Omega-3

'Consumption of omega-3 fatty acids assists in maintaining healthy triglyceride levels, provided that it is associated with a balanced diet and healthy lifestyle'.

Carotenoids - Lycopene, lutein and zeaxanthin

'Carotenoids (compound name) has antioxidant action that protects cells against free radicals. Its consumption should be associated with a balanced diet and healthy lifestyle habits'.

Food Fibers

Food fibers, resistant dextrin, fructooligosaccharide, partially hydrolyzed guar gum, inulin, lactulose, polydextrose, beta glucan and psillium

'Food fibers help the bowel to function. Its consumption should be associated with a balanced diet and healthy lifestyle habits'.

Phytosterols

'Phytosterols help reduce cholesterol absorption. Its consumption should be associated with a balanced diet and healthy lifestyle habits'.

Soy Protein

'Daily consumption of at least 25 g of soy protein may help reduce cholesterol. Its consumption should be associated with a balanced diet and healthy lifestyle habits'.

Chitosan

'Chitosan helps in reducing the absorption of fat and cholesterol. Its consumption should be associated with a balanced diet and healthy lifestyle habits'.

Polyols: Mannitol, xylitol, sorbitol

'Mannitol/xylitol/sorbitol does not produce acids that damage the teeth. The consumption of the product does not substitute adequate habits of oral hygiene and feeding'.

Probiotics

*Lactobacillus acidophilus, casei shirota, casei variedade rhamnosus, casei variedade defensis, paracasei, lactis. Bifidobacterium bifidum, animallis (*including the subspecie *B. lactis), longum*and *Enterococcus faecium.*

'The (indicate the species of the microorganism) (probiotic) contributes to the balance of the intestinal flora. Its consumption should be associated with a balanced diet and healthy lifestyle habits'.