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FOOD TECHNOLOGY

Composition differences between organic and conventional processed foods: a meta-analytical study

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ABSTRACT: *Comparisons between the nutritional quality of organic and conventional fresh foods are frequently reported in the literature; however, discussion about processed foods is less frequent. Therefore, this study compared the nutritional content of processed products from both production systems using a systematic review of the literature and meta-analysis, regarding aspects of raw material management and processing. The study reviewed scientific articles published between 2010 and 2020 and the data obtained were analyzed using the standardized mean difference method with Hedges' adjustment and a random analytical model. Thirty-seven articles were selected, and the foods analyzed in the studies were grouped into five categories: meat products, dairy products, caught fish, wines, and fruit juices/pulps. In products of animal origin, the comparative focus shown was mainly that of the fatty acid profile, while in those of vegetable origin it was that of phytochemicals. Related to the comparison of nutrient contents, it was possible to verify the similarities in organic and conventional products in most studies; however, specific differences were verified (P < 0.05): organics contained more proteins (meat), omega 3 (dairy), and less linoleic acid (dairy and caught fish). Also, there were differences in the management of organic and conventional raw materials, and similarities in processing. Therefore, the choice for organic processed foods should not be made exclusively based on nutritional aspects, considering that the differences in nutrient contents in relation to those of conventional products are practically nonexistent.*
Key words: *nutrients, comparison, production system, systematic review, meta-analysis.*

Diferenças de composição entre alimentos processados orgânicos e convencionais: um estudo meta-analítico

RESUMO: *Frequentemente são encontradas na literatura comparações entre a qualidade nutricional dos alimentos orgânicos e convencionais in natura, no entanto, pouco se discute acerca dos processados. Assim sendo, o objetivo desse estudo foi comparar o teor nutricional dos processados de ambos os sistemas de produção utilizando uma revisão sistemática da literatura e meta-análise, associando a aspectos de manejo das matérias-primas e processamento. Para isso, buscou-se artigos científicos publicados entre 2010 e 2020 e os dados obtidos foram analisados utilizando o método da diferença média padronizada com ajuste de Hedges e modelo analítico aleatório. Trinta e sete artigos foram selecionados, e os alimentos analisados em tais estudos foram agrupados em cinco categorias: cárneos, lácteos, pescado, vinhos e sucos/polpas de frutas. Nos produtos de origem animal o foco comparativo evidenciado foi principalmente o do perfil de ácidos graxos, enquanto nos de origem vegetal foi o dos fitoquímicos. Em relação à comparação do teor de nutrientes, foi possível constatar a similaridade nos orgânicos e nos convencionais na maioria dos estudos, entretanto, diferenças pontuais foram verificadas (P < 0,05): orgânicos com mais proteínas (cárneos), ômega 3 (lácteos) e menos ácido linoleico (lácteos e pescado). Também, notaram-se diferenças no manejo das matérias-primas orgânicas e convencionais, e similaridade no processamento. Portanto, a escolha por alimentos processados orgânicos não deve ser feita exclusivamente baseada em aspectos nutricionais, tendo em vista que as diferenças nos teores dos nutrientes em relação aos convencionais são praticamente inexistentes.*
Palavras-chave: *nutrientes, comparação, sistema de produção, revisão sistemática, meta-análise.*

INTRODUCTION

Organic foods are the products of a production system that according to IFOAM (2008) aims to promote the health of soils, ecosystems, and people by carrying out ecological processes that value biodiversity and cycles appropriate to local conditions, and avoids inputs with adverse effects. In addition, such a system combines the use of traditional and innovative practices with scientific knowledge

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to favor the shared environment and provide fair relationships and quality of life for those involved. The growth of the market for organic foods has been highlighted in scientific articles (DANGOUR et al., 2010; KASHIF et al., 2020; MASSEY et al., 2018). In addition, a global study demonstrated a trend towards organic production, given that data related to the amount of land destined for organic production and data related to the retail sale of organic foods and drinks indicated an increase of more than 500% throughout the world from 1999 to 2018 (WILLER et al., 2020).

To support the continuation of this growth, it is important to understand the expectations of consumers when purchasing such products. In this context, it is common to believe that organic products have superior quality over conventional ones (ASIOLI et al., 2014; HASIMU et al., 2017; KASHIF et al., 2020; MASSEY et al., 2018). In relation to this possible difference in quality, studies indicated that consumers highlight a belief in the superior nutrient content over that of conventional products (ASIOLI et al., 2014; HASIMU et al., 2017; MASSEY et al., 2018), which is still questionable (ZALECKA et al., 2014).

Therefore, in order to obtain more robust evidence on the comparison of nutrient content between organic and conventional, the present study was carried out. An analysis of scientific articles related to the topic published in the last ten years, using a systematic review methodology with meta-analysis was conducted (PALUPI et al., 2012; ŚREDNICKA-TOBER et al., 2016; MDITSHWA et al. 2017). It compared the quality of organic processed foods with that of conventional ones, in relation to nutritional composition, highlighting relations of the results obtained with aspects of handling raw materials and their processing methods. It should be noted that the focus of the study was restricted to processed foods in view of the lack in the literature of reviews with meta-analysis on this specific segment.

MATERIALS AND METHODS

Systematic review

Seeking to find studies with data that would help answer the question *Do organic processed foods have more nutrients than conventional ones?,* the Scopus (www.scopus.com/) and Web Science (www.webofknowledge.com) databases were consulted using the following search criteria: scientific articles published in the English language between January 2010 and February 2020, containing a certain combination of words (Organic OR ecologic OR "Health food" OR "food sustainability" AND Conventional AND Food OR "Processed Food" OR "Grain product" OR "Cereal product" OR "Vegetable product" OR "Animal Product" AND Compare OR Comparison AND Nutrition OR Quality).

The total number of articles found was 19,555. Subsequently, the titles were read, duplicate papers reported in the databases were excluded, and the summaries of potential articles for inclusion were read. Such actions reduced the search to 219 documents.

The next step consisted of reading each of the 219 articles and verifying that they met the following selection criteria: scientific articles published in English language containing primary data that directly compared the nutrient content of organic and conventional processed foods, published in peer-reviewed journals, containing the description of the laboratory methods used and also information on the number of samples analyzed, average nutrient content, and standard deviation or standard error. This study considered as processing the performance of at least one unit operation on fresh foods in order to increase the shelf life, including minimum processing.

After applying these criteria, 63 articles were selected. In order to obtain more relevant comparisons, the documents were separated according to the class of food to which they referred. The tabulation of the selected articles indicated that for various nutrients in the different food matrices the minimum number of three articles for meta-analytical comparison was not achieved; a criterion that must be met according to LIPSEY & WILSON (2000). Therefore, there was a need to exclude 26 studies, that is, to remove all studies related to nutrients that did not have at least three comparative studies. Thus, only 37 articles were effectively used in the meta-analysis.

Meta-Analysis

After selecting the studies, the meta-analysis was carried out. For this, we used the standardized mean difference method with Hedges' adjustment and, considering a priori that the effect sizes between the studies would be heterogeneous, we chose the random model as suggested by FIELD & GILLETT (2010).

Hedges' adjusted g technique is among the best choices for comparing two or more groups, given its ability to calculate the effect size regardless of the heterogeneity of sample sizes, measurement units, and results of statistical tests (PALUPI et al., 2012; SANCHEZ-MECA & MARIN-MARTINEZ, 2010; HEDGES & OLKIN, 1985); however, it requires mentioning the sample size, the mean, and the standard deviation to be applied (ST-PIERRE, 2001).

The calculations were performed as described in DEEKS & HIGGINS (2010). The accuracy of the effect sizes was described using a 95% confidence interval. The significance of the difference in the overall cumulative effect size of each nutrient in each food group was verified by the Z test at the level of 5% probability.

All calculations were performed using the Review Manager 5.3 software (Cochrane Collaboration, Oxford, United Kingdom) for Windows.

Management of raw materials and processing technology in organic and conventional production

After conducting the systematic review and meta-analysis, the results obtained were compared regarding the aspects of handling the raw materials and those related to the processing methods of organic and conventional modalities. For this, the information available in the scientific articles selected by the systematic review was consulted, as well as that contained in national and international technical regulations.

RESULTS AND DISCUSSION

The systematic review as previously described implied the selection of different food products, organized into five groups: meat products, dairy products, caught fish, wines, and fruit juices/pulps. It is worth mentioning that studies were also found with products such as tea, honey, baby food, coffee, flour (wheat flour, corn flour, and rice flour), ketchup, vegetable oil, and eggs; however, as they did not fully meet the previously defined criteria, they were not considered.

Meat products

In the meat group, nutrients from various minimally processed chilled or frozen cuts were analyzed, such as: chicken meat such as wing, neck, gizzard, liver, heart, breast, and thigh (ABDULLAH & BUCHTOVA, 2016; KÜÇÜKYILMAZ et al., 2012; LV & ZHAO, 2017); pork meat such as loin and shank (KARWOWSKA & DOLATOWSKI, 2013; PREVOLNIK et al., 2011), beef meat such as loin and *Supraspinatus* muscle (RIBAS-AGUSTÍ et al., 2019; TURNER et al., 2015), and lamb meat such as loin (PRACHE et al., 2011; SOYSAL et al., 2011).

As shown in table 1, for meat products, the systematic review was able to capture studies that mainly compared the fatty acid profile of organic and conventional products.

Table 1 - Results of the meta-analysis for the nutritional composition of meat products in relation to organic and conventional production systems.

Nutrient	Number of studies	Total samples analyzed	Cumulative effect size	± 95%Cl	P-value
Protein*	5	527	0.78	0.765	0.04
Lipids	7	787	-0.28	0.645	0.40
C14:0	4	224	0.07	1.280	0.92
C16:0	4	224	-0.15	0.815	0.72
C18:0	4	224	0.77	0.875	0.08
Saturated fatty acids	4	290	0.22	0.255	0.09
C16:1, 9c	4	224	0.64	1.465	0.39
C18:1, 9t	3	194	1.49	1.720	0.09
C18:1, 9c	4	224	0.06	0.915	0.90
Monounsaturated fatty acids	4	290	-0.03	0.575	0.92
C18:2, n-6	4	224	-0.39	0.570	0.18
C18:3, n-3	4	224	0.68	0.980	0.17
C20:4, n-6	4	224	-1.05	1.345	0.12
Polyunsaturated fatty acids	3	254	0.20	0.570	0.49
Omega 6	3	248	-0.74	1.045	0.17
Omega 3	3	248	-0.42	1.350	0.54
Cholesterol	3	162	-0.46	0.880	0.31

* Significant variable at the level of 5% by the application of the Z test in relation to the size of the cumulative effect, that is, the content of the referred nutrient varies according to the production method. A positive value indicates a tendency for superiority in organic products. A negative value indicates a tendency of superiority in conventional products.
Source: Research results.

The results shown in table 1 indicated that only the protein content showed a statistically significant positive difference at the level of 5% in the size of the cumulative effect, indicating; therefore, a tendency of superiority in organic meat products. ABDULLAH & BUCHTOVA (2016) and LV & ZHAO (2017) believe that this superiority is related to the fact that animals under organic management have greater motor activity as a result of being able to move in a wider space and; therefore, have a tendency for greater myogenesis (formation of muscle tissue) compared to animals in conventional systems, which is in line with what was reported by CASTELLINI et al. (2002) and by HUSAK et al. (2008). Again as a result of greater motor activity, ABDULLAH & BUCHTOVA (2016), CASTELLINI et al. (2002), HUSAK et al. (2008), and LV & ZHAO (2017) also mentioned the possibility of lower fat content in organic meat products; however, this study did not confirm this expectation.

As an example of the difference in space, we can mention the study on broiler chicken carried out by ABDULLAH & BUCHTOVA (2016), in which under organic management there was a density of 10 birds/m^2, with access to an outdoor area during the summer as defined by the COMUNIDADE EUROPEIA (2008), whereas in conventional management, the density was 18/m^2 without access to the outside area. Therefore, there is a clear difference in the space provided to animals in the two production systems during the fattening process, certainly with improved animal welfare for those in organic management; however, without relevant nutritional differences in the final product.

Regarding the processing techniques carried out from slaughter to obtaining meat cuts from cattle, pigs, chicken, and lambs; no operational difference justified a difference in nutrient content between organic and conventional production systems. In addition, meat cuts evaluated from the two systems were not permitted to receive any additives, and their preservation was achieved by physical processes, which in the case of the products covered in this study were refrigeration or freezing.

Therefore, the difference between the two systems evaluated for the meat products investigated basically were related to the handling conditions of the raw materials, which, as previously informed, did not significantly impact the nutritional differences for most of the investigated nutrients (fat, fatty acids, omega 6, omega 3, and cholesterol), while for protein there was a tendency for higher levels in the organic products.

Dairy products

In the dairy group, nutrients from several products were analyzed, such as: pasteurized milk (BUTLER et al., 2011; CHUNG et al., 2018; FLORENCE et al., 2012b; LIU et al., 2018; O’DONNELL et al. , 2010); UHT milk (BENBROOK et al., 2013); fermented milk (FLORENCE et al., 2012a; FLORENCE et al. 2012b); and butter (PUSTJENS et al., 2017).

In this group, as shown in table 2, it is noted that the systematic review also basically captured comparative studies of the fatty acid profile. It is also worth mentioning the statistical significance at the level of 5% in the size of the cumulative effect (positive trend) of the omega 3 fatty acids, that is, for these nutrients there was an indication of superiority in the organic products. In addition, it was found that for linoleic acid (9, 12-octadecadienic acid - C18: 2), which belongs to the omega 6 group, there was also statistical significance at the same level of probability; however, the trend was negative.

BENBROOK et al. (2013); O’DONNELL et al. (2010); PALUPI et al. (2012); and ŚREDNICKA-TOBER et al. (2016) believe that this trend of higher omega 3 content and lower omega 6 content (mainly linoleic acid) in organic dairy products is related to the fact that animals in this production system are generally more pasture fed than in the conventional system, that is, the diet could affect this fatty acid profile. The dry matter requirement from pasture in the diets of lactating cows, for example, is at least 50% according to the Brazilian organic certification standard (BRASIL, 2011) and at least 30% according to the American one (RINEHART & BAIER, 2011).

Another relevant aspect in relation to the comparison of conventional and organic dairy products, especially for thermally treated fluid milks, which are the most prominent products of this class covered in this document, are the processing technologies, whose unit operations are the same in both the systems. Therefore, this technological similarity ends up reinforcing the arguments described in the previous paragraph, which possible differences (not evidenced for most of the investigated nutrients) in composition to these products would be more related to the handling of raw materials than to processing.

Despite the similarity in processing, it should be noted that in the case of organic UHT milks, there are greater restrictions in relation to authorized additives. In Brazil, for example, conventional products may have the addition of sodium citrate, sodium monophosphate, sodium diphosphate, and sodium triphosphate as stabilizers (BRASIL, 1997), while organics can only have addition of sodium citrate (BRASIL, 2009).

Table 2 - Results of the meta-analysis for the nutritional composition of dairy products in relation to the organic and conventional production systems.

Nutrient	Number of studies	Total samples analyzed	Cumulative effect size	± 95%Cl	P-value
C4:0	6	607	1.00	1.905	0.30
C6:0*	6	608	2.64	2.115	0.01
C8:0*	6	608	2.37	2.065	0.03
C10:0*	6	608	3.01	2.340	0.01
C14:0*	6	608	2.83	2.380	0.02
C15:0*	5	584	4.66	2.925	0.002
C16:0	7	632	-0.23	2.550	0.86
C17:0*	6	608	2.47	1.415	0.0006
C20:0*	5	598	0.84	0.200	<0.00001
C22:0*	4	305	1.76	1.075	0.001
Total saturated fatty acid	7	760	-0.53	0.875	0.24
C14:1	3	283	1.37	1.710	0.12
C18:1	4	325	-0.08	1.055	0.88
Total monounsaturated fatty acid	7	760	0.52	1.025	0.32
C18:2*	3	282	-1.92	-0.300	<0.00001
Total polyunsaturated fatty acid	7	759	0.84	1.045	0.11
Omega 6	3	362	1.76	2.840	0.22
Omega 3*	3	363	3.13	1.570	<0.0001

* Significant variable at the level of 5% by the application of the Z test in relation to the size of the cumulative effect, that is, the content of the referred nutrient varies according to the production method. A positive value indicates a tendency for superiority in organic products. A negative value indicates a tendency of superiority in conventional products.
Source: Research results.

This greater permissiveness in conventional UHT milks in Brazil could potentially increase the sodium content when compared to organic milks. However, in this document, studies that evaluated this parameter were not captured, thus making any conclusion about it impossible. In the case of organic and conventional pasteurized milks, it is worth mentioning that there is no permission to add any additive and/or technology adjuvant (BRASIL, 2018).

Caught fish

In the caught fish group, nutrients from several products were analyzed, such as: frozen salmon fillet (LERFALL et al., 2016a), salted and smoked salmon fillet (LERFALL et al., 2016b), cooled carp fillet (BALEV et al., 2017), and frozen sea bream fillet (MENTE et al., 2012). Through the analysis of table 3, it is noted that the systematic review also basically captured comparative studies to the fatty acid profile. In this group, one can highlight the statistical significance at the level of 5% in the size of the cumulative effect (negative trend) of linoleic acid, similar to that reported in dairy products.

LERFALL et al. (2016a); LERFALL et al. (2016b); and SUÁREZ et al. (2014) point out in their respective studies that the fatty acid profiles of fish are related to the lipid composition of their respective diets. In the case of LERFALL et al. (2016a) and LERFALL et al. (2016b), for example, conventional diets contained vegetable oils as a source of lipids, while in organic diets it was fish oil, which has a reduced content of such fatty acid in its composition compared to vegetable oils.

In addition to the diet, it is worth noting the differences in animal density in organic and conventional farms: LERFALL et al. (2016a) studied salmon raised in ponds with a density of 10 kg/m^3 and 25 kg/m^3 respectively, for organic and conventional, while MENTE et al. (2012) studied sea bream in farms with a density of 4 kg/m^3 and 15 kg/m^3 respectively, for organic and conventional. It should be noted that the organic management parameters of these authors followed that defined by the COMUNIDADE EUROPEIA (2008). Therefore, as with the meat products analyzed previously, the difference in space that the animals of the two production systems are

Table 3 - Results of the meta-analysis for the nutritional composition of caught fish in relation to organic and conventional production systems.

Nutrient	Number of studies	Total samples analyzed	Cumulative effect size	± 95%Cl	P-value
Lipids	3	216	-0.06	0.265	0.64
C14:0*	3	28	10.21	6.170	0.001
C16:0	3	28	2.65	2.795	0.06
C18:0	3	28	-0.61	0.810	0.14
C16:1*	3	28	7.62	2.750	<0.00001
C18:2*	3	28	-11.31	10.880	0.04
C18:3	3	28	-11.19	13.030	0.09

* Significant variable at the level of 5% by the application of the Z test in relation to the size of the cumulative effect, that is, the content of the referred nutrient varies according to the production method. A positive value indicates a tendency for superiority in organic products. A negative value indicates a tendency of superiority in conventional products.
Source: Research results.

subjected to during the fattening process is evident, but that does not seem to significantly affect the nutritional characteristics in the final product.

Regarding the processing techniques used to obtain the meat cuts of the products covered in this part of the study, it should be noted that they were identical when comparing organic and conventional products, showing; therefore, that it is not an important factor when comparing fish from the two productive systems analyzed.

Wines and fruit juices/pulps

In the wine group, nutrients were analyzed from white wines (DUTRA et al., 2018; TASSONI et al., 2013; TOBOLKOVÁ et al., 2014; VRCEK et al., 2011) and red wines (GARAGUSO & NARDINI, 2015; LAUREATI et al., 2014; MULERO et al., 2010; TASSONI et al., 2013; TOBOLKOVÁ et al., 2014; VRCEK et al., 2011). In the case of fruit juices and pulps, fermented beet juices (KAZIMIERCZAK et al., 2014), passion fruit pulps (MACORIS et al., 2012), grape juices (MARGRAF et al., 2016; GRANATO et al. ., 2015; DUTRA et al., 2018), tomato juice (HALLMANN et al., 2013; VALLVERDÚ-QUERALT et al., 2012), orange juice (DOLINSKY et al., 2018; FREEDMAN & MIRABRISHAMI, 2015), and beet juice (KAZIMIERCZAK et al., 2016) were included.

For wines and fruit juices/pulps, the results of which are shown respectively in tables 4 and 5, it is noted that the comparison between organic and conventional modalities available in the literature was fundamentally based on vegetable phytochemicals, which are biologically active compounds with great beneficial health potential.

The belief in the literature is that organic vegetable foods have a higher content of phytochemicals such as flavonoids and phenolics for example (CRINNION, 2010; DOLINSKY et al. 2018; HALLMANN, 2012). GYÖRE-KIS et al. (2012) even highlight in their study with tomatoes the concept that the techniques used in the cultivation of organic crops can activate natural defense mechanisms in tomatoes, increasing the content of compounds such as polyphenols in the respective fruits and; consequently, in their products. However, despite these theories, this document has not confirmed such a trend in post-processing products.

In relation to grape processing techniques for obtaining wine, there is a great similarity between organic and conventional ones; however, the difference tolerated in the sulfur dioxide addition limit (SO_2), which is used in these products to prevent the development of undesirable microorganisms and oxidation, stands out as an exception (MULERO et al., 2010). For Brazilian standards, for example, the maximum authorized limits are 300mg/L for conventional (BRASIL, 2016) and 100mg/L for organic (BRASIL, 2009). By European standards, the maximum values for conventional are 150mg/L (red) and 200mg/L (white and rosé) according to the COMUNIDADE EUROPEIA (2009), and for organic are 100mg/L (red) and 150mg/L (white and rosé) according to the COMUNIDADE EUROPEIA (2012). Despite this greater rigidity in the organic regulations, it is noted that wine producers tend to work with values lower than the maximum allowed: MULERO et al. (2010) for example performed grape vinification techniques of the *Monastrell* variety

Table 4 - Results of the meta-analysis for the nutritional composition of wine products in relation to organic and conventional production systems.

Nutrient	Number of studies	Total samples analyzed	Cumulative effect size	± 95%Cl	P-value
Anthocyanins	3	17	-1.27	3.260	0.44
Flavonoids	4	33	0.21	0.745	0.58
Total phenolics	3	29	-0.27	0.805	0.50
Catechin	4	76	-0.56	0.850	0.20
Caffeic acid	3	35	-0.69	1.705	0.43
Syringic acid	3	29	-0.34	0.805	0.40
p-Coumaric acid	3	35	-1.16	1.810	0.21
Rutina	3	33	1.07	3.145	0.51
Myricetin	3	28	-1.73	4.260	0.43
Quercetin	4	45	0.05	2.605	0.97

Source: Research results.

using, respectively, 70 and 80 mg/L of SO_2 in organic and conventional wines, while TASSONI et al. (2013) processed organic and conventional grapes of the *Sangiovese* variety with; respectively, 5 and 15 mg/L of SO_2.

In addition, it is worth noting that despite the absence of specification in technical regulations for the period of maceration in the two systems analyzed, there may be differences as defined by the producer. In the study by TASSONI et al. (2013), for example, it was possible to notice a difference in the processing of grapes of the same variety in the organic (15 days) and conventional (10 days) systems, without explaining the technical justifications for this. Conversely in the study by VRCEK et al. (2011), the winemaking techniques for several grape varieties in the organic and conventional systems were described, and it was possible to show the similarity in the stages for the same variety in both systems.

In the case of fruit juices, there is also a similarity in the processing techniques of organic and conventional juices, it being common, for example, for processors to produce both types of juices using common equipment. In addition, research by HALLMANN et al. (2013), KAZIMIERCZAK et al. (2014), and MACORIS et al. (2012) studied products obtained from both production systems using the same operations unit. However, when comparing the specific technical regulations for organic and conventional juices, some differences are observed. In Brazil, for example, the use of preservatives in conventional juices is authorized, such as sodium sorbate and sodium benzoate (BRASIL, 2013); in organic products they are not allowed (BRASIL, 2009). The use of these additives in conventional products; although, it is increasingly declining due to available technologies (aseptic packaging, for example) and due to the negative appeal with consumers, can increase the sodium content in them when compared to organic juices. Another permitted practice that is evidenced exclusively in conventional products regards the use of defoamer (dimethylsilicone, dimethylpolysiloxane, polydimethylsiloxane), which facilitates the performance of certain processing steps (BRASIL, 2009; BRASIL, 2013), and which does not seem to cause relevant changes in the nutritional content of food.

Therefore, despite the differentiated permissions reported in articles and technical regulations in relation to some additives for wines and organic and conventional fruit juices/pulps, it was noted that the processing techniques in the two production systems are quite similar and that there were no nutritional differences.

General aspects

Using a systematic review with meta-analysis, it was possible to compile the results of several comparative studies of the last ten years between organic and conventional foods, in relation to the nutritional content, even evaluating some aspects of handling the respective raw materials and processing.

One of the search filters was for the food to be processed without restricting it to a certain type of food matrix, that is, that the food had gone through at least some processing before being offered to the consumer. This was done in order to highlight this market niche, which until now has not been explored in meta-analytical studies.

Table 5 - Results of the meta-analysis for the nutritional composition of fruit juices/pulps in relation to organic and conventional production systems.

Nutrient	Number of studies	Total samples analyzed	Cumulative effect size	± 95%Cl	P-value
Soluble solids (Brix)	4	114	-0.64	1.005	0.21
Total phenolics	5	147	0.76	1.255	0.23
Polyphenols	3	46	-0.13	0.640	0.69
Flavonoids	4	128	0.08	0.355	0.67
Vitamin C	6	164	0.16	0.425	0.48
Phenolic acids	4	87	0.10	0.515	0.70
Gallic acid	5	149	0.08	0.635	0.80
Chlorogenic Acid	6	182	0.78	1.065	0.15
p-Coumaric acid	3	107	-0.69	0.915	0.14
Quercetin	4	99	1.37	1.910	0.16
Kaempferol	3	66	0.11	0.510	0.68
Caffeic acid	5	158	0.56	1.290	0.40
Ferulic acid	3	104	-0.54	0.695	0.13

Source: Research results.

During the research, it was evidenced that in products of animal origin the investigation focused mainly on the profile of fatty acids, while those of vegetal origin they focused on the phytochemicals. Regarding the comparison of the nutrient content of the analyzed products, the results obtained showed that in most cases the difference between production systems is non-existent, that is, no sufficiently robust results allowed the organic to be superior to conventional products in relation to nutritional content. However, it should be noted that for some specific nutrients such as protein in meat and omega 3, in dairy products there was a tendency for higher levels in organic products, with animal management aspects as justification in the literature. Some aspects related to the processing methods were also discussed, which are generally similar in the two production systems, with specific differences shown in the respective technical regulations analyzed.

Finally, it is worth noting the scarcity of comparative articles on organic and conventional processed products, which resulted in restricting the comparison in this research, between more nutrients of the studied food groups and also the comparison between other products.

CONCLUSION

This study was developed with the main objective of comparing the nutritional content of organic and conventional processed foods. When evaluating the selected studies, it was evidenced that the research on products of animal origin focused mainly on the lipid profile and those carried out on foods of vegetable origin on phytochemicals. Regarding the comparison of nutrient contents, no relevant differences in the vast majority of cases analyzed were reported. Therefore, in view of the search carried out on studies published in the last ten years, it appears that it is not reasonable to justify the choice of organic processed foods by the nutritional content alone.

Finally, it is worth mentioning that meta-analytical studies covering scientific articles that analyze other products and nutrients must be carried out in order to expand the conclusions about the comparison between organic and conventional processed foods.

DECLARATION OF CONFLICT OF INTEREST

The authors declare no conflict of interest. The founding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

AUTHORS' CONTRIBUTIONS

All authors contributed equally for the conception and writing of the manuscript. All authors critically revised the manuscript and approved the final version.

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