

## Original

# Knowledge, interest, predisposition and evaluation of functional foods in Spanish dietitians-nutritionists and experts in human nutrition and dietetics

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## Abstract

**Introduction:** Little research has been conducted into the attitudes and knowledge of dietitians-nutritionists (DN) or of experts in human nutrition and dietetics (EHND) regarding functional foods (FFs).

**Objectives:** To evaluate the knowledge of, interest in and predisposition towards FFs in Spanish DN and EHND, and how these professionals rate the potential benefits and risks associated with consuming FFs.

**Methods:** 2100 DN and 122 EHND were asked to participate in a self-administered questionnaire. The results were expressed using percentages and the DN responses were compared with those of the EHND by means of chi-squared test. A significant difference was regarded as having been obtained if  $P < 0.05$ .

**Results:** 204 DN and 112 EHND responded. After eliminating 45 surveys due to anomalies, 268 surveys were analyzed (170 from the DN, 8.1% participation; 98 from the EHND, 80.3% participation). No statistically significant differences were observed between the responses of the DN and the EHND except in: 1) the view that it was "dangerous" to consume certain FFs  $\geq 4$  times a day; and 2) the knowledge of the population regarding in which situations certain FFs should be consumed. Most of the professionals demonstrated good knowledge of FFs, consumed FFs, showed a positive attitude towards FFs and thought that the information provided to the consumer is insufficient.

**Discussion and conclusions:** FFs are generally accepted by nutritional professionals. However, further study is required into the discrepancies between DN and EHND regarding the view that it is "dangerous" to consume certain FFs and regarding their evaluation of whether the public know in which situations certain FFs should be consumed.

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## CONOCIMIENTOS, INTERÉS, PREDISPOSICIÓN Y VALORACIÓN SOBRE ALIMENTOS FUNCIONALES POR PARTE DE DIETISTAS-NUTRICIONISTAS Y EXPERTOS EN NUTRICIÓN HUMANA Y DIETÉTICA ESPAÑOLES

## Resumen

**Introducción:** La actitud y los conocimientos de los dietistas-nutricionistas (DN) o de los expertos en nutrición humana y dietética (ENhD) en relación a los alimentos funcionales (AFs) ha sido poco investigada.

**Objetivos:** Evaluar en DN y en ENhD españoles el conocimiento sobre AFs, el interés y la predisposición hacia ellos, así como su valoración sobre los potenciales beneficios y riesgos asociados a su consumo.

**Métodos:** Se solicitó a 2100 DN y a 122 ENhD su participación en una encuesta autoadministrada. Se valoraron los resultados mediante porcentajes y se compararon las respuestas de DN con las de ENhD mediante el test de chi-cuadrado. Se consideró diferencia significativa si  $P < 0,05$ .

**Resultados:** Respondieron 204 DN y 112 ENhD. Tras eliminar 45 encuestas por incongruencias, se analizaron 268 encuestas (170 de DN, 8,1% de participación; 98 de ENhD, 80,3% de participación). No se observaron diferencias estadísticamente significativas entre las respuestas de DN y ENhD excepto en: 1) la consideración como "peligroso" el hecho de consumir  $\geq 4$  veces/día determinados AFs; y 2) el conocimiento de la población acerca de en qué situaciones consumir determinados AFs. La mayoría de los profesionales estudiados presentan buenos conocimientos sobre AFs, los consume, muestran una actitud positiva hacia ellos, y considera que la información aportada al consumidor es insuficiente.

**Discusión y conclusiones:** Los AFs son en general aceptados por los profesionales de la nutrición. Sin embargo, la discrepancia observada acerca de la consideración como "peligroso" un alto consumo de determinados AFs, y del conocimiento de la población sobre cuándo consumir determinados AFs requiere ser estudiada con mayor profundidad.

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Palabras clave: *Actitud del personal sanitario. Alimentos funcionales. Conocimientos. Dietistas-Nutricionistas. Encuesta.*

## Abbreviations

List of abbreviations that appear in the body of the study.

AEDN: Asociación Española de Dietistas-Nutricionistas, Spanish Association of Dietitians-Nutritionists.

CLA: Conjugated Linoleic Acid.

DN: Dietitians-Nutritionists.

EFSA: European Food Safety Authority.

EHND: Experts in Human Nutrition and Dietetics.

FF: Functional Food.

FUFOSE: Functional Food Science in Europe.

GDA: Guideline Daily Amount.

HN and D: Human Nutrition and Dietetics.

ILSI: International Life Sciences Institute.

MeSH: Medical Subject Headings.

RCT: Randomized Controlled Trial.

## Introduction

The concept of “functional food” (FF) emerged in Japan around 1980 and is defined as: “any product or ingredient that, in addition to possessing nutritional value, has a positive impact on the health, physical performance or mental state of the individual”. In Japan, functional foods are classified under the term FOSHU, which stands for *Food with Specified Health Uses*, and the Japanese government supports health declarations associated with these foods in order to improve the health of the population.<sup>1</sup>

Although in Europe there is no official definition for FFs,<sup>2</sup> a European Commission project named “Functional Food Science in Europe” (FUFOSE) and coordinated by the *International Life Sciences Institute (ILSI Europe)* proposed a definition in 1999<sup>3</sup> that is generally accepted by the scientific community.<sup>4</sup> According to this definition, a FF is any food that has been satisfactorily demonstrated to have a beneficial effect on one or more target functions in the body in addition to the food’s intrinsic nutritional effects. According to the European definition, an FF should always be a recognized food; that is, its effects should result from its consumption as a foodstuff in normal quantities and as part of a conventional diet.<sup>5</sup>

This concept is different from the definition proposed in 1994 by the Institute of Medicine of the American *National Academy of Sciences*, which stated that for a food to be considered functional it must have been modified in some way.<sup>6</sup> Nevertheless, both the *International Life Sciences Institute (ILSI) of North America* and the *American Dietetic Association* include both non-modified foods and modified foods in their lists of FFs.<sup>7,8</sup> More recently (2010), the thesaurus (Medical Subject Headings, MeSH) of the American *National Library of Medicine* has defined “functional foods” as “those components of a regular diet that can bring health benefits

beyond those provided by the basic nutrients”,<sup>9</sup> a definition that coincides with the aforementioned European Commission proposal.

As Professor Roberfroid stated in 2002, FFs are now principally a scientific product that is useful for developing and stimulating research into new products.<sup>10</sup> In this regard, we have looked at the PubMed database to determine how this research has evolved since the descriptor “Functional Food” was included in it in 2010. Whereas between January and August of 2010 91 articles were published (seven of which were Randomized Controlled Trials (RCTs)), in the same period during 2011 32 articles were published (none of which was an RCT). An analysis of this decrease is beyond the scope of the present study, although the decrease may be due to the economic recession and the resulting cuts in companies’ research spending.<sup>11</sup>

Despite this downward trend in the number of scientific publications, the outlook for the market in FFs in Europe and the United States is good, even in the context of an economy that is passing through difficult moments.<sup>12,13</sup> The data available indicate that not only has the market in FFs grown in recent years,<sup>14</sup> but so too has the interest of both industry and consumers in these foods.<sup>13</sup> Because health professionals are potential prescribers of FFs and are in privileged position to influence the correct use of them, it is important to evaluate their knowledge of, interest in, predisposition towards and evaluation of these foods. Various studies have evaluated the general public’s opinion of and interest in FFs.<sup>15,16</sup> However, few studies have focused on dietitians-nutritionists (DN) or on experts in human nutrition and dietetics (EHND).<sup>17-20</sup>

For this reason, the aim of the present study was to evaluate Spanish DN and EHND to determine their knowledge of, interest in and predisposition towards FFs and their assessment of the potential benefits and associated risks of consuming these foods.

## Material and methods

In May 2008, an email was sent to the 2100 members of the Spanish Association of Dietitians-Nutritionists (Asociación Española de Dietistas-Nutricionistas, AEDN) who had an email address, and to 122 EHND selected by the researchers of the present study on the basis of data provided by the board of directors of the AEDN. All were asked to participate anonymously in a self-administered online survey. The survey collected data regarding participants’ age, sex, education, current profession, years of experience, and their answers to 16 multiple choice questions regarding FFs (see Annex 1).

The subjects responded to the survey in May 2008. In March 2010 a poster was published at the 2nd FESNAD 2010 Conference containing the most important results arising from the analysis of the questionnaire.<sup>21</sup> The present study presents a more detailed analysis of the questionnaire.

**ANNEX 1**  
**SELF-ADMINISTERED QUESTIONNAIRE (ON-LINE) ANSWERED BY DN AND EHND 1.**

1. **Do you know what functional foods are?**  
Yes  
No  
NA
2. **Do you think that functional food will bring many benefits to public health?**  
Yes, many benefits (give details)  
Few benefits  
None, one can get the same benefits eating well  
Don't know  
NA
3. **If you think that functional foods will bring many benefits to public health, can you explain why? (You can choose more than one answer.)**  
Because we eat very badly  
Because a normal diet does not meet the body's nutritional requirements  
Because of our sedentary lifestyle  
For other reasons  
In certain physiological/pathological situations they help us to meet dietary requirements  
They provide us with extra benefits/added value  
Other reasons
4. **Functional foods are increasing being consumed. Do you think that the market for this type of food will reach saturation point?**  
Yes, in 2 years  
Yes, in 5 years  
Yes, in 10 years  
No  
Don't know  
NA
5. **Do you consume functional foods?**  
Yes, often  
Yes, sometimes  
No, because I do not believe they are useful  
No, because they are more expensive  
No, for other reasons  
NA  
Specify other reasons:  
No, because I do not need them  
No, for other reasons
6. **What is the biggest problem concerning functional foods? (You can choose more than one answer.)**  
They are more expensive  
I do not think they are natural foods  
Sometimes the benefits are unknown  
Sometimes the possible negative effects of consuming them are unknown  
They medicalize food  
Other reasons (dishonest advertising, incorrect use, the belief that consuming them leads to a balanced diet, other reasons)
7. **Which of these foods can be considered functional? (You can choose more than one answer)**  
Breast milk  
Virgin olive oil  
Milk enriched with omega 3  
Brown bread  
Yoghurt
8. **Which is the target population for yoghurts enriched with phytosterols?**  
Individuals with heart problems  
Individuals with high cholesterol  
Individuals who take medicines to treat their high cholesterol  
Pregnant women with high cholesterol  
Individuals with excess weight  
Don't know  
NA
9. **Do you think that the public knows precisely in which situations the following foods should be consumed?**  
Milk enriched with calcium (yes/no/NA)  
Bio yoghurt (yes/no/NA)  
Margarine with phytosterols (yes/no/NA)  
Cocoa powder with fibre (yes/no/NA)
- Milk with conjugated linoleic acid (CLA) (yes/no/NA)  
Eggs rich in omega 3 (yes/no/NA)  
Fruit juice enriched with antioxidants (yes/no/NA)  
Flour enriched with folic acid (yes/no/NA)  
Iodized salt (yes/no/NA)
10. **Do you think the following foods can be consumed by everybody?**  
Milk enriched with calcium (yes/no/NA)  
Bio yoghurt (yes/no/NA)  
Margarine with phytosterols (yes/no/NA)  
Cocoa powder with fibre (yes/no/NA)  
Milk with conjugated linoleic acid (yes/no/NA)  
Eggs rich in omega 3 (yes/no/NA)  
Fruit juice enriched with antioxidants (yes/no/NA)  
Flour enriched with folic acid (yes/no/NA)  
Iodized salt (yes/no/NA)
11. **Do you think it is dangerous to consume any of the following foods more than 4 times a day?**  
Milk enriched with calcium (yes/no/NA)  
Bio yoghurt (yes/no/NA)  
Margarine with phytosterols (yes/no/NA)  
Cocoa powder with fibre (yes/no/NA)  
Milk with conjugated linoleic acid (yes/no/NA)  
Eggs rich in omega 3 (yes/no/NA)  
Fruit juice enriched with antioxidants (yes/no/NA)  
Flour enriched with folic acid (yes/no/NA)  
Iodized salt (yes/no/NA)
12. **What do you think is the main reason for the presence of so many functional foods on the market?**  
Because of advances in science  
Because it is in the interests of the industry to sell more  
Because consumers are increasingly concerned about their health  
Don't know  
Other reasons  
NA  
Other reasons:  
Comfort  
Because of the first three options  
Because of the first and third options  
Because of the second and third options  
Because of the first and second options
13. **Do you think there is sufficient information regarding the functional foods on sale in the supermarkets?**  
Yes, enough  
Not entirely  
The information is insufficient  
Don't know  
NA
14. **How do you think consumers should be informed about functional foods? (You can choose more than one answer)**  
All the important information should be printed on the packaging (ticket or box)  
Public bodies should make specific campaigns  
The current information provided to the consumer is sufficient  
The information should be provided in supermarkets or at points of sale  
Don't know
15. **Is there any Spanish or European regulation concerning the presence of effective and safe functional foods on the market?**  
No  
Yes, but it is insufficient  
Yes, and it is sufficient, but nobody really checks to ensure that it is complied with  
The truth is that everything is very tightly controlled and it is difficult to appear on the market a food that is fraudulent or dangerous to public health  
Don't know  
NA
16. **Which sector do you think has the highest sales of functional foods?**  
The breakfast cereals sector  
The dairy sector  
The non-alcoholic drinks sector  
The biscuit and pastry sector  
Don't know  
NA

**Table I**  
Sample characteristics

Sample characteristics	Total	DN	EHND	P
n	268	170	98	
Age (years)	31 ± 11	28 ± 7	37 ± 14	< 0.001
Women [n (%)]	217 (81)	144 (85)	73 (74.5)	0.040
<i>Education</i>				
Degree in medicine (%)	9.0	1.8	21.4	
Degree in pharmaceuticals (%)	3.0	1.8	5.1	
Another degree (%)	7.8	6.5	10.2	
Diploma in HN and D (%)	76.9	85.3	62.2	
Diploma in nursing (%)	0.7	0.6	1.0	
Another diploma (%)	2.6	4.1	0.0	
<i>Years of professional experience</i>				
Less than 5 years (%)	64.2	78.8	38.8	
Between 5 and 10 years (%)	13.1	13.5	12.2	< 0.001
More than 10 (%)	21.3	5.9	48.0	
No response (%)	1.1	1.8	1.0	
<i>Are you currently practicing?</i>				
Yes (%)	81.7	77.6	88.8	
No (%)	17.5	21.8	10.2	0.017
No response (%)	0.7	0.6	1	

The continuous variables are presented as means and as standard deviations (SDs), and the data for the categorical variables are shown in percentages (%). The  $\chi^2$  test was used to compare the qualitative variables and *t-student* was used to compare non-paired samples of quantitative variables. Compliance with the application conditions of the tests was verified and the usual level of significance of  $P < 0.05$  was used for the bilateral contrasts. The statistical analyses were carried out using the SPSS Statistics software for Windows (version 17.0, SPSS Inc, Chicago, IL).

## Results

### Sample characteristics

204 DN and 112 EHND answered the questionnaire. 45 questionnaires were eliminated (32 from the DN and 13 from the EHND) due to anomalies in the responses. Consequently, 268 questionnaires were analyzed (170 from the DN, 8.1% participation; 98 from the EHND, 80.3% participation). Table I shows the sample characteristics. 15% of the DN were male, whereas this figure rose to 74% for the EHND. Only 5.9% of the DN had more than 10 years professional experience, whereas almost half of the EHND (48%) had more than 10 years professional experience.

### Knowledge of FFs

As table II shows, four questions are directly related to the knowledge of DN and EHND regarding FFs. No statistically significant differences were observed between the answers given by the DN and EHND.

Practically all the respondents (99.3%) stated that they knew what FFs were. However, when they were asked to choose the “functional” foods from a closed list, although the vast majority (94.8%) classified omega-3 enriched milk as an FF, only a minority (17.9%) gave the same classification to breast milk, virgin olive oil (17.5%), brown bread (25%) or yoghurt (31.7%).

Most of the respondents (92.2%) agreed that individuals with hypercholesterolemia were the target population for yoghurts enriched with phytosterols. A minority (2.6%) thought that yoghurts enriched with phytosterols could be taken by people with hypercholesterolemia who were undergoing treatment with statins.

Finally, only 4.9% of the respondents said they unaware of any Spanish or European regulation concerning the presence of effective and safe functional foods on the market.

### Interest in FFs, evaluation of their possible benefits, and predisposition towards them

No statistically significant differences were observed between the responses of the DN and the EHND to the

**Table II**  
*Questions regarding knowledge of FFs among DN and EHND*

<i>Questions regarding knowledge of FFs among DN and EHND</i>	<i>Total</i>	<i>DN</i>	<i>EHND</i>	<i>P</i>
<i>Do you know what functional foods are?</i>				
Yes (%)	99.3	98.8	100.0	
No (%)	0.4	0.6	0.0	0.446
NA (%)	0.4	0.6	0.0	
<i>Which of these foods can be considered as functional? (You can choose more than one answer)</i>				
Breast milk (%)	17.9	16.5	20.4	0.418
Virgin olive oil (%)	17.5	15.3	21.4	0.203
Omega 3-enriched milk (%)	94.8	95.9	92.9	0.284
Brown bread (%)	25.0	22.9	28.6	0.305
Yoghurt (%)	31.7	27.1	39.8	0.031
<i>Which is the target population for yoghurts enriched with phytosterols?</i>				
Individuals with heart problems (%)	1.9	1.8	2.0	
Individuals with high cholesterol (%)	92.2	92.4	91.8	
Individuals who take medicines to treat their high cholesterol (%)	2.6	2.9	2.0	0.946
Pregnant women with high cholesterol (%)	–	0.0	1.0	
Individuals with excess weight (%)	–	0.0	0.0	
Don't know (%)	0.8	0.6	1.0	
NA (%)	26	2.4	3.1	
<i>Is there any Spanish or European regulation concerning the presence of effective and safe functional foods on the market?</i>				
No (%)	4.9	5.9	3.1	
Yes, but it is insufficient (%)	43.3	42.9	43.9	
Yes, and it is sufficient, but nobody really checks to ensure that it is complied with (%)	16.0	15.3	17.3	0.370
The truth is that everything is very tightly controlled and it is difficult to appear on the market a food that is fraudulent or dangerous to public health (%)	11.2	8.8	15.3	
Don't know (%)	22.8	24.7	19.4	
NA (%)	1.9	2.4	1.0	

3 questions regarding their interest in FFs, their evaluation of their possible benefits, and their predisposition towards them (table III).

46.3% of the respondents thought that FFs would bring “many benefits” to public health in the future. 34.3% of the respondents believed that FFs would provide “few benefits”, and a minority (16%) thought that FFs would provide no benefits, because “one can obtain the same benefits by eating well”. 27.6% of those respondents who thought that FFs would bring many benefits to public health said that this was because “people eat very badly”.

When asked whether they consumed FFs, most stated that they did eat them either “sometimes” (54.9%) or “often” (11.2%). Of particular note among the reasons for not consuming FFs are the responses “because I do not need them” (13.1%) and “because I do not believe they are useful” (12.3%).

*Evaluation of the potential problems or risks associated with the consumption of FFs*

Four questions in the survey were related to how DN and EHND rate the potential problems or risks associated with the consumption of FFs (Annex 2). No statistically significant differences were observed between the responses of the DN and EHND, except for in two questions, which are explained in the following paragraphs.

The respondents said that “the biggest problem with some FFs” was that “they were more expensive” (57.5%) and that “sometimes the possible benefits of consuming them are unknown” (53.4%).

Most DN and EHND agreed that the public does not know when it is recommended to consume Bio yoghurt (54.1%), cocoa powder with added fibre (54.9%) and milk with conjugated linoleic acid (CLA) (79.9%). 55% of the respondents thought that the public knew



**Table III**  
*Questions regarding the interest of DN and EHND in FFs, their evolution of their possible benefits, and their predisposition towards them*

<i>Questions regarding the interest of DN and EHND in FFs, their evolution of their possible benefits, and their predisposition towards them</i>	<i>Total</i>	<i>DN</i>	<i>EHND</i>	<i>P</i>
<i>Do you think that functional foods will bring many benefits to public health?</i>				
Yes, many benefits (%)	46.3	48.8	41.8	
Few benefits (%)	34.3	31.8	38.8	
None, one can get the same benefits eating well (%)	16.0	15.3	17.3	0.360
Don't know (%)	2.6	3.5	1.0	
NA (%)	0.7	0.6	1.0	
<i>If you think that functional foods will bring many benefits to public health, can you explain why? (You can choose more than one answer).</i>				
Because we eat very badly (%)	27.6	28.8	25.5	0.559
Because a normal diet does not meet the body's nutritional requirements (%)	8.2	9.4	6.1	0.345
Because of our sedentary lifestyle (%)	18.3	21.2	13.3	0.107
For other reasons (%)	17.9	13.5	25.5	0.014
Specify other reasons:				
In certain physiological/pathological situations they help us to meet dietary requirements (%)	6.3	5.9	7.1	0.345
They provide us with extra benefits/added value (%)	5.6	4.1	8.2	0.336
Other reasons (%)	6.0	3.5	10.2	0.014
<i>Do you consume functional foods?</i>				
Yes, often (%)	11.2	11.8	10.2	
Yes, sometimes (%)	54.9	55.3	54.1	
No, because I do not believe they are useful (%)	12.3	11.2	14.3	
No, because they are more expensive (%)	5.6	6.5	4.1	
No, for other reasons (%)	15.3	14.1	17.3	0.794
NA (%)	0.7	1.2	0.0	
Specify other reasons:				
No, because I do not need them (%)	13.1	12.9	13.3	
No, for other reasons (%)	2.2	1.2	4.1	

when iodized salt should be consumed. The DN and EHND disagreed ( $P < 0.001$  for all values) about whether the population knew when certain FFs should be consumed, as shown in figure 1.

Most of the respondents thought that everybody could consume Bio yoghurt (80.6%), cocoa powder with added fibre (59.3%), eggs enriched with omega-3 (64.2%), fruit juice enriched with antioxidants (81.7%), flour enriched with folic acid (60.1%) and iodized salt (57.8%). On the other hand, for most of the respondents the FFs that could not be consumed by everybody were margarine with phytosterols (64.9%) and milk with CLA (69.4%). Half of the respondents (50%) thought that milk enriched with calcium could be consumed by everybody, whereas almost all of the remainder (48.5%) thought that this was not the case.

Most of the respondents thought it dangerous to consume  $\geq 4$  times a day margarine with phytosterols (68.7%) or eggs enriched with omega-3 (67.2%). Figure 2 shows that the DN and EHND disagreed ( $P < 0.001$  for all values, except Bio yoghurt,  $P < 0.05$ ) regarding the statement that it was dangerous to consume more than  $\geq 4$  times a day milk enriched with calcium (42.9% of DN against 22.4% of EHND), Bio yoghurt (25.3% of DN against 14.3% of EHND) and milk with CLA (64.7% of DN against 44.9% of EHND).

#### *Other questions*

No statistically significant differences were observed between the responses of the DN and EHND to the 5

**ANNEX 2**  
**QUESTIONS REGARDING THE EVALUATION OF DN AND EHND OF THE POTENTIAL PROBLEMS**  
**OR RISK ASSOCIATE WITH THE CONSUMPTION OF FFs**

Questions regarding the evaluation of DN and EHND of the potential problems or risk associate with the consumption of FFs	Total	DN	EHND	P
<i>What do you think is the biggest problem concerning functional foods? (You can choose more than one answer)</i>				
They are more expensive (%)	57.5	56.5	59.2	0.665
I do not think they are natural foods (%)	6.0	5.3	7.1	0.538
Sometimes the benefits are unknown (%)	53.4	52.4	55.1	0.664
Sometimes the possible negative effects of consuming them are unknown (%)	39.2	40.0	37.8	0.717
They medicalize food (%)	26.9	25.9	28.6	0.632
Other reasons (%)	15.3	14.1	17.3	0.479
Specify other reasons:				
Dishonest advertising (%)	5.2	3.5	8.2	
Incorrect use of functional foods (%)	2.2	2.9	1.0	
The belief that consuming functional foods leads to a balanced diet (%)	3.0	2.9	3.1	0.365
Other reasons (%)	4.9	4.7	5.1	
<i>Do you think that the public knows precisely in which situations the following foods should be consumed?</i>				
Milk enriched with calcium (%)				<0.001
Yes	44.8	36.5	59.2	
No	53.7	61.8	39.8	
NA	1.5	1.8	1.0	
Bio yoghurt (%)				0.696
Yes	44.0	44.7	42.9	
No	54.1	52.9	56.1	
NA	1.9	2.4	1.0	
Margarine with phytosterols (%)				<0.001
Yes	56.7	76.5	22.4	
No	41.8	21.8	76.5	
NA	1.5	1.8	1.0	
Cocoa powder with fibre (%)				0.667
Yes	41.8	42.9	39.8	
No	54.9	54.1	56.1	
NA	3.4	2.9	4.1	
Milk with conjugated linoleic acid (%)				0.281
Yes	17.2	15.3	20.4	
No	79.9	81.8	76.5	
NA	3.0	2.9	3.1	
Eggs rich in omega 3 (%)				<0.001
Yes	56.0	81.2	12.2	
No	42.2	17.1	85.7	
NA	1.9	1.8	2.0	
Fruit juice enriched with antioxidants (%)				<0.001
Yes	53.7	65.3	33.7	
No	44.0	32.4	64.3	
NA	2.2	2.4	2.0	
Flour enriched with folic acid (%)				<0.001
Yes	58.6	88.8	6.1	
No	39.2	8.8	91.8	
NA	2.2	2.4	2.0	
Iodized salt (%)				0.070
Yes	55.2	59.4	48.0	
No	42.9	38.8	50.0	
NA	1.9	1.8	2.0	
<i>Do you think the following foods can be consumed by everybody?</i>				
Milk enriched with calcium (%)				0.749
Yes	50.0	48.8	52.0	
No	48.5	48.8	48.0	
NA	1.5	2.4	0.0	
Bio yoghurt (%)				0.207
Yes	80.6	77.6	85.7	
No	17.9	20.0	14.3	
NA	1.5	2.4	0.0	
Margarine with phytosterols (%)				0.526
Yes	32.5	33.5	30.6	
No	64.9	62.9	68.4	
NA	2.6	3.5	1.0	

**ANNEX 2 (cont.)**  
**QUESTIONS REGARDING THE EVALUATION OF DN AND EHND OF THE POTENTIAL PROBLEMS**  
**OR RISK ASSOCIATE WITH THE CONSUMPTION OF FFs**

Questions regarding the evaluation of DN and EHND of the potential problems or risk associate with the consumption of FFs	Total	DN	EHND	P
Cocoa powder with fibre (%)				0.892
<i>Yes</i>	59.3	58.8	60.2	
<i>No</i>	38.1	38.2	37.8	
<i>NA</i>	2.6	2.9	2.0	
Milk with conjugated linoleic acid (%)				0.555
<i>Yes</i>	26.1	25.9	26.5	
<i>No</i>	69.4	70.6	67.3	
<i>NA</i>	3.7	2.4	6.1	
Eggs rich in omega 3 (%)				0.106
<i>Yes</i>	64.2	68.2	57.1	
<i>No</i>	33.2	30.0	38.8	
<i>NA</i>	2.6	1.8	4.1	
Fruit juice enriched with antioxidants (%)				0.619
<i>Yes</i>	81.7	82.4	80.6	
<i>No</i>	16.8	15.9	18.4	
<i>NA</i>	1.5	1.8	1.0	
Flour enriched with folic acid (%)				0.756
<i>Yes</i>	60.1	59.4	61.2	
<i>No</i>	36.9	37.6	35.7	
<i>NA</i>	3.0	2.9	3.1	
Iodized salt (%)				0.549
<i>Yes</i>	57.8	58.8	56.1	
<i>No</i>	41.0	39.4	43.9	
<i>NA</i>	1.1	1.8	0.0	
<i>Do you think it is dangerous to consume any of the following food more than 4 times a day?</i>				
Milk enriched with calcium (%)				<0.001
<i>Yes</i>	35.4	42.9	22.4	
<i>No</i>	57.1	51.2	67.3	
<i>NA</i>	7.5	5.9	10.2	
Bio yoghurt (%)				0.038
<i>Yes</i>	21.3	25.3	14.3	
<i>No</i>	71.6	68.2	77.6	
<i>NA</i>	7.1	6.5	8.2	
Margarine with phytosterols (%)				0.678
<i>Yes</i>	68.7	67.6	70.4	
<i>No</i>	26.9	27.6	25.5	
<i>NA</i>	4.5	4.7	4.1	
Cocoa powder with fibre (%)				0.297
<i>Yes</i>	36.9	40.0	31.6	
<i>No</i>	56.3	55.3	58.2	
<i>NA</i>	6.7	4.7	10.2	
Milk with conjugated linoleic acid (%)				0.011
<i>Yes</i>	57.5	64.7	44.9	
<i>No</i>	32.5	28.2	39.8	
<i>NA</i>	10.1	7.1	15.3	
Eggs rich in omega 3 (%)				0.614
<i>Yes</i>	67.2	68.8	64.3	
<i>No</i>	27.2	26.5	28.6	
<i>NA</i>	5.6	4.7	7.1	
Fruit juice enriched with antioxidants (%)				0.175
<i>Yes</i>	19.8	17.6	23.5	
<i>No</i>	71.6	75.3	65.3	
<i>NA</i>	8.6	7.1	11.2	
Flour enriched with folic acid (%)				0.527
<i>Yes</i>	29.1	28.2	30.6	
<i>No</i>	63.1	65.3	59.2	
<i>NA</i>	7.8	6.5	10.2	
Iodized salt (%)				0.215
<i>Yes</i>	44.0	47.1	38.8	
<i>No</i>	50.7	48.2	55.1	
<i>NA</i>	5.2	4.7	6.1	



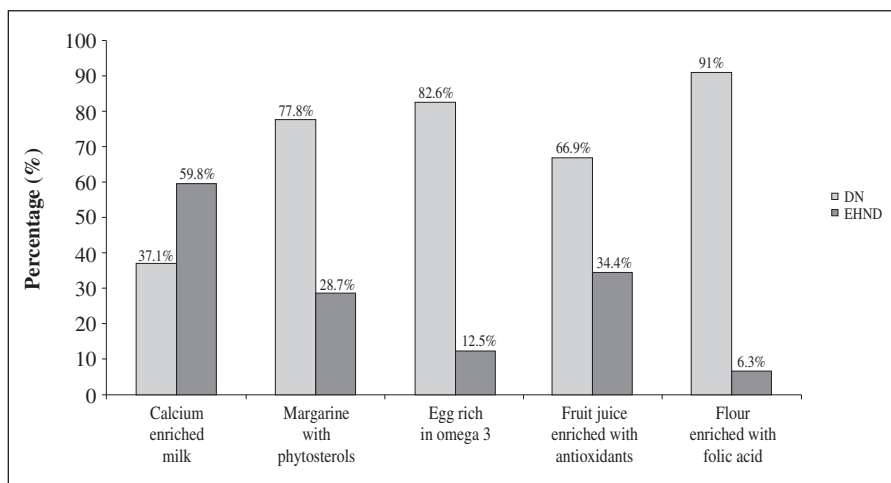


Fig. 1.—Percentage of DN and EHND who think that the public know in which situations to consume certain FFs,  $P < 0.001$  for all values.

questions regarding their evaluations of the other questions on FFs (Annex 3).

Most of the respondents (53.3%) said that they did not know if the FF market would reach saturation point. 31.3% of the respondents thought that the FF market would never become saturated. 46.3% thought that the main reason for the existence of so many FFs was “because it was in the industry’s interests to sell more of them”. Most of the respondents (69.8%) thought that information about the FFs on sale in supermarkets was insufficient. 79.1% stated that all the important information about FFs aimed at consumers should be shown on the packaging (on the label or box), and 76.9% stated that “public bodies should carry out specific campaigns”. Only a small minority (1.1%) thought that the information on FFs aimed at the public was sufficient. Finally, when asked “Which sector do you think sells the most functional foods?” the vast majority (87.7%) said “the dairy sector”.

## Discussion

The attitude and knowledge of professionals in nutrition regarding FFs are on the whole homogenous for two questions: the percentage of DN and EHND who think that the public knows in which situations

certain FFs should be consumed; and the percentage of DN and EHND who thought it “dangerous” to consume certain FFs  $\geq 4$  times a day. The following is a brief analysis of their responses to the questions in the survey.

### Knowledge of FFs

Practically all the respondents stated that they knew about FFs. This coincides with the results of a study carried out on a random sample taken from all the DN in Oregon. That study only asked the DN what they thought they knew about FFs<sup>18</sup>, whereas the present study asked the respondents to classify certain foods as “functional” or “non-functional”. Although most classified milk enriched with omega-3 as an FF,<sup>22-24</sup> only a minority of these also classified breast milk, virgin olive oil, brown bread or yoghurt as FFs. However, these foods can be considered FFs if we apply the European Commission’s definition,<sup>3</sup> which is generally accepted by the scientific community,<sup>4</sup> or that of the American *National Library of Medicine*.<sup>9</sup> According to these definitions, an FF is a food that provides health benefits beyond the effects of the nutrients that it contains, and that can be both a natural food or one that has had a component added, removed or modified.<sup>5</sup>

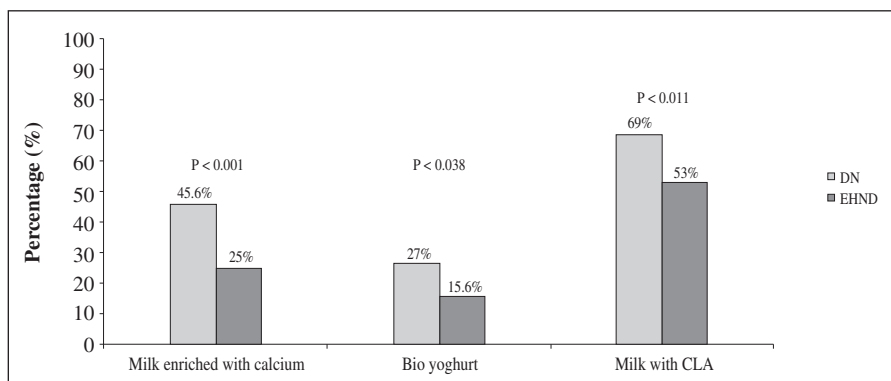


Fig. 2.—Percentage of DN and EHND who consider it “dangerous” to consume certain FFs more than  $\geq 4$  times a day. CLA = Conjugated Linoleic Acid.

**ANNEX 3**  
**QUESTIONS REGARDING THE EVALUATION OF DN AND EHND OF OTHER QUESTIONS RELATING TO FUNCTIONAL FOODS. NO STATISTICALLY SIGNIFICANT DIFFERENCES ARE OBSERVED BETWEEN DN AND EHND**

Questions regarding the evaluation of DN and EHND of other questions relating to functional foods.	Total	DN	EHND	P
<i>Functional foods are increasing being consumed. Do you think that the market for this type of food will reach saturation point?</i>				
Yes, in 2 years (%)	3.0	2.4	4.1	
Yes, in 5 years (%)	7.1	8.2	5.1	
Yes, in 10 years (%)	5.2	2.9	9.2	0.041
No (%)	31.3	35.9	23.5	
Don't know (%)	53.0	50.0	58.2	
NA (%)	0.4	0.6	0.0	
<i>What do you think is the main reason for the presence of so many functional foods on the market?</i>				
Because of advances in science (%)	9.0	7.6	11.2	
Because it is in the interests of the industry to sell more (%)	46.3	47.1	45.4	
Because consumers are increasingly concerned about their health (%)				0.769
Don't know (%)	33.6	34.1	33.0	
Other reasons (%)	0.4	0.6	0.0	
NA (%)	9.0	8.2	10.3	
Other reasons:	1.9	2.4	1.0	
Comfort	0.7	1.2	0.0	
Other reasons	1.5	1.8	1.0	
Because of the first three options	3.4	2.9	4.1	
Because of the first and third options	1.9	0.6	0.0	
Because of the second and third options	0.7	1.2	4.1	
Because of the first and second options	0.7	0.6	1.0	
<i>Do you think there is sufficient information regarding the functional foods on sale in the supermarkets?</i>				
Yes, enough (%)	0.0	0.0	0.0	
Not entirely (%)	28.4	27.1	30.6	
The information is insufficient (%)	69.8	70.6	68.4	0.579
Don't know (%)	0.0	0.0	0.0	
NA (%)	1.9	2.4	1.0	
<i>How do you think consumers should be informed about functional foods? (You can choose more than one answer)</i>				
All the important information should be printed on the packaging (ticket or box) (%)	79.1	82.4	73.5	0.085
Public bodies should make specific campaigns (%)	76.9	80.6	70.4	0.057
The current information provided to the consumer is sufficient (%)	1.1	1.8	0.0	0.186
The information should be provided in supermarkets or at points of sale (%)	33.2	32.4	34.7	0.695
Don't know (%)	1.1	0.0	3.1	0.022
<i>Which sector do you think has the highest sales of functional foods?</i>				
The breakfast cereals sector (%)	3.0	3.5	20	
The dairy sector (%)	87.7	86.5	89.8	
The non-alcoholic drinks sector (%)	1.9	2.4	1.0	0.829
The biscuit and pastry sector (%)	1.9	1.8	2.0	
Don't know (%)	4.1	3.5	5.1	
NA (%)	1.5	2.4	0.0	

This is the case with breast milk,<sup>25</sup> virgin olive oil,<sup>26,27</sup> brown bread,<sup>28</sup> and yoghurt.<sup>29</sup>

It is possible that most of the respondents only regarded as FFs those foods that have been modified in some way, in line with the definition proposed in 1994 by the Institute of Medicine of the American *National Academy of Sciences*,<sup>6</sup> a definition that is not accepted by the current scientific community.<sup>3,4,9</sup> Our study reveals, in any case, that the perceptions of the participating DN and EHND regarding their own knowledge of FFs does not faithfully reflect the reality. It is important for health professionals involved in nutrition to have a solid understanding of FFs.

Despite this, there is a clear understanding of who the target population is for yoghurts enriched with phytosterols, because most of the respondents stated that they were aimed at hypercholesterolemic individuals. In this regard the European Food Safety Authority (EFSA) believes that a cause-effect relationship has been established between the consumption of phytosterols and reduced LDL cholesterol,<sup>30</sup> and that these substances should only be consumed by people who need to reduce the levels of cholesterol in their blood.<sup>31</sup> A minority of the DN and EHND thought that yoghurts enriched with phytosterols could be taken by individuals with high cholesterol who were taking statins. The EFSA indicates that such patients should consume this product under medical supervision,<sup>31</sup> which shows that most of the DN and EHND gave the correct response.

Finally, when asked if there was any Spanish or European regulation concerning the presence of effective and safe functional foods on the market, the majority were right in saying that there was.<sup>2</sup>

#### *Interest in FFs, evaluation of their possible benefits, and predisposition towards them*

The present study investigated to the interest of DN and EHND in FFs, their evaluation of their possible benefits, and their predisposition towards them. The data obtained do not support the findings of the study by Landström and co-workers. In their qualitative study carried out in Sweden they found that doctors and patients expressed more scepticism and distrust towards FFs than did DN.<sup>32</sup> However, the respondents were not experts in human nutrition and dietetics, as is the case in the present study.

Almost half of our respondents showed a positive predisposition towards FFs in that they thought that FFs would bring “many benefits” to public health. This coincides with the data from a study carried out on a random sample of DN from Oregon, which showed that the vast majority of the respondents expressed positive attitudes towards FFs and thought them to be effective and safe for the prevention and treatment of illnesses.<sup>18</sup>

Roughly a third of our respondents thought that FFs would provide “few benefits”, and a sixth thought that

FFs would bring no benefits. In other studies, both DN and doctors stated that following a healthy diet is more important than consuming FFs, and were disinclined to recommend FFs.<sup>17,19</sup> In this regard, an interesting editorial published recently by Frank Hu of Harvard University indicates that the beneficial effects of individual foods or ingredients on health (be they functional or not) are modest if they are compared with a general change in the dietary pattern.<sup>33</sup>

Most of our respondents consume FFs, which coincides with the findings of other similar studies.<sup>18,20</sup> This is important because the consumption of FFs by DN may be strongly related to their tendency to recommend them.<sup>20</sup>

#### *Evaluation of the potential problems or risks associated with the consumption of FFs*

Most DN and EHND coincided in their evaluation of the potential problems or risks associated with the consumption of FFs, but they disagreed on whether the public knows in which situations the consumption of certain FFs is justified. These discrepancies may, as suggested by Landström and co-workers in a similar study,<sup>31</sup> be related to aspects that have not been explored in the present study, such as the degree of specific knowledge about FFs, or the respondents' degree of competence in nutritional matters. Whatever the reason, this perception on the part of DN and EHND regarding the public's lack of knowledge about when to consume certain FFs could be interpreted as a feeling of risk, on the part of DN and EHND, associated with their consumption.

Out of a list of nine FFs, most of the respondents thought that six could be consumed by everybody (Bio yoghurt, cocoa powder, eggs enriched with omega-3, fruit juice enriched with antioxidants, flour enriched with folic acid and iodized salt). We have found no studies that recommend against the consumption of these FFs by the general public. Most of the respondents agreed that two FFs (margarine with phytosterols and milk with CLA) cannot be consumed by everybody. This coincides with the position of the EFSA, which states that foods enriched with phytosterols may not be suitable for pregnant women, lactating women or children,<sup>30,31</sup> and that conjugated linoleic acid supplements may not be suitable for patients with Type 2 diabetes.<sup>34</sup> This reinforces the finding that the respondents have a high level of understanding of FFs. For the remaining FF, milk enriched with calcium, half of the respondents thought that this could be consumed by everybody, whereas the other half thought that this was not the case. This is a discrepancy that, if converted into two opposing dietary recommendations, may cause confusion among patients treated by DN or EHND.

Most DN and EHND thought that it is dangerous to consume margarine with phytosterols or eggs enriched

with omega 3  $\geq$  4 times a day. Leaving to one side the possible risks associated with an increased consumption of phytosterols and omega 3, 4 daily portions of margarine provide 36.5% of the Guideline Daily Amount (GDA) of energy, and 4 eggs provide 19.5% of the GDA of energy.<sup>35-37</sup> If this rate of consumption were to be repeated habitually, it could cause a dietary imbalance.

DN and EHND did not coincide in regarding the consumption of milk enriched with calcium  $\geq$  4 times a day as dangerous (fig. 2). This discrepancy could be clinically important because although it is well known the multiple positive effects of a diet with enough calcium,<sup>38,39</sup> some studies indicate that excess intake of calcium is not exempt from possible risks.<sup>40</sup> The two sets of respondents also disagreed regarding the assertion that consumption of  $\geq$  4 daily portions of Bio yoghurt or milk with CLA was dangerous. We have found no studies indicating potential harmful effects associated with the consumption of four portions a day of Bio yoghurt. However, regarding milk with CLA, a review published by Salas-Salvadó and co-workers in 2006 revealed potential risks associated with the consumption of CLA.<sup>41</sup> The EFSA states that the safety of consuming CLA supplements has not been established beyond six months.<sup>34</sup>

When drawing up guidelines for FFs, health professionals should be aware that the use of these foods may increase the risk of pharmacological interactions (due to the high content of specific functional ingredients in certain FFs), and the likelihood that people will self-medicate (using FFs), which may cause them not to strictly adhere to a properly recommended pharmacological treatment.<sup>42</sup>

### Other questions

Most of the respondents stated that they did not know if the market in FFs would become saturated. When asked what they thought was the main reason for the presence of so many FFs on the market, the highest scoring response was "because it is in the industry's interests to sell more". As was mentioned in the introduction, the market in FFs has grown exponentially in recent years.<sup>14</sup> When the respondents were asked "Do you think there is sufficient information regarding the functional foods for sale in the supermarket?" most thought that the information was insufficient. This is important because ensuring that consumers receive information about FFs may influence their attitude towards them.<sup>4</sup>

Finally, when asked "Which sector do you think has the highest sales of functional foods?", the vast majority gave the correct answer: "the dairy sector".<sup>43</sup>

One of the possible limitations to the present study is the time lapse between when the DN and EHND responded to the survey (May 2008) and when the data were analysed (July-August 2011). Nevertheless, the

basic concepts contained in the questionnaire have not changed during this time. Another limitation is that the present study does not analyse all of the FFs on the market, although the authors have made every effort to include the most representative FFs. The low participation rate on the part of the DN (8.1%, 170 individuals) is another possible limitation when extrapolating our results to all Spanish DN, given that those who responded may have better knowledge of the subject matter. Finally, there are obvious inherent limitations to the instrument used to collect the information (i.e. the self-administered questionnaire).

### Conclusions

The DN and EHND showed a high level of homogeneity in their responses. Most said that they knew what FFs were, and demonstrated good knowledge of them, although they were unaware that certain unmodified foods (e.g. virgin olive oil) can be classified as FFs. Most consume FFs, show a positive attitude towards them, believe they will provide many benefits to public health and consider that the consumer is provided with insufficient information regarding FFs. A comparison of the two groups shows statistically significant differences for the two questions regarding 1) whether they thought it was "dangerous" to consume certain FFs  $\geq$  4 times a day, and 2) whether the public knew in which situations to consume certain FFs. This needs to be studied in greater depth to evaluate its possible implications.

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