

The drivers of the usage intention of Spirulina algae in food in different market segments

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Abstract

In a quantitative survey with 1589 participants from Flanders, the Dutch speaking part of Belgium, the determinants of the adoption intention of functional food containing Spirulina (a micro alga) are explored. The usage intention of this novel food product is measured for different socio-demographic and lifestyle groups and the drivers and barriers towards usage intention are investigated. The results show that women, people in between 30-55 years old, individuals who are very much into food and often cook themselves and vegetarians and sporting people, are the market segments that are most inclined to adopt Spirulina food. People are more motivated to use Spirulina in food when they are more familiar with the alga and when they are more ready to give up good taste for the benefits of Spirulina. Also health concerns (health consciousness, a healthy lifestyle) are important drivers of usage intention. Foodneophobia has a negative effect on usage intention. Ecological concern and considerations of good taste do not affect usage intention. Implications for Spirulina food marketers are offered.

Keywords: functional food, Spirulina, drivers and barriers of usage intention

1. Introduction: context and research objectives

Meat consumption accounts for a significant portion of the ecological footprint of humans, due to the significant contribution of animal production to greenhouse gas emissions (Guinée et al., 2006). In order to decrease food-related greenhouse gas emissions and to maintain a sustainable environment, alternative delivery of proteins are needed (Garnett, 2011; WWF 2012). Micro algae based food products provide a partial solution to this problem. One of these micro-algae is *Spirulina* that, besides proteins (e.g. phycocyanin), also contains high-value compounds such as pigments (e.g. astaxanthin), anti-oxidants (e.g. β -carotene), fatty acids (e.g. omega-3, docosahexaenoic acid - DHA and eicosapentaenoic acid e EPA), and vitamins (especially B12, C and D2). *Spirulina* is also considered as an ecological friendly alternative for supplying a substantial portion of the EU food and feed market since it only demands a limited production surface (Draaisma et al., 2013; OECD, 2013) and has low emission effect. Despite the benefits of *Spirulina*, it has the disadvantage of having a specific taste and color. The pigment is strong and has an influence on the natural color of the food it is added to.

Spirulina can be positioned in the market as two different product types (Enzing et al., 2014). The first type is dried algae which can be directly sold as dietary supplements and have the potential to be used in bulk commodities as sources of proteins and carbohydrates. This kind of products are already available in several markets. The second type is specialty products isolated and extracted from the micro-algae that can be added to foods to improve their nutritional value. Adding *Spirulina* in food products categorize these products as functional foods. The market of functional foods is growing rapidly (USD 43.27bn. in 2013), with a lot of functional foods products emerging in recent years (Verbeke 2005, Menrad 2003, Vergari et al., 2010), but seems to stagnate (Leatherhead Food research, 2013). Apart from hedonic and nutritional functions, functional foods are consumed for their physiological and well-being benefits (Hasler and Brown, 2009), and are also considered as products that can prevent potential chronic disease to develop.

Although the benefits and market potential for *Spirulina* are promising, the products currently on the market are still limited and insights about their market viability is scarce. A number of authors provide general information on micro algae based food products, but none of them concentrate on the EU (Pulz and Gross, 2004; Spolaore et al; 2006). Investing in the development of a promising new food category without studying its potential consumers may underlie the failure of a great proportion of new food products.

A lot of previous research on functional food acceptance primarily focused on socio-demographic characteristics to classify consumers that are more or less willing to use functional food. (Bower et al., 2003; Barreiro-Hurlé et al., 2008; Øvrum et al., 2012; Teratanavatand Hooker, 2005; Nordström, 2012; Hellyer et al., 2012; Hu et al., 2011; Markosyan et al., 2007). However, other researchers posit that explaining food consumption is no longer possible by means of traditional socio-demographic segmentation. They focus on lifestyles and values to classify consumers that are willing to adopt functional foods (e.g., Szakaly et al., 2012). Since food products are not just means for survival and pleasure, many other drivers and barriers affect consumer's (functional) food consumption decisions (Pouta et al., 2010; Chountalas et al., 2009). Early research already mentioned the positive effects of knowledge and beliefs on the readiness to try functional foods (IFIC, 1999). Di Pasquale et al. (2011) report the importance of health issues, environmental and social issues and economic aspects. Other studies mention attributes such as nutritional value, quality and beneficial

health effects as well as expected taste and geographical origin as influential for the acceptance of food (Berrena and Sanchez, 2013). In the area of health issue motivations, studies investigated the effect of, for instance, belief in one's own impact on personal health (Hilliam, 1996), health benefit belief (Childs, 1997), perception of health claims (Bech-Larsen & Grunert, 2003), belief in the food-disease prevention concept (Wrick, 1995), belief in the disease-preventative nature of natural foods (Childs and Poryzees, 1998), and opinions about the relationship between food and health (Niva, 2000). These studies mostly demonstrate a positive correlation of all these factors with the acceptance of functional food. However, there are also barriers to the adoption of functional foods. For instance, negative taste expectation is negatively correlated with willingness to try novel food (Raats et al., 1995). Food neophobia, once an important survival mechanism, is associated with decreased levels of intention to eat novel food (Dovey et al., 2008, Verbeke, 2015).

The purpose of the present study is to explore the willingness to use Spirulina in food and to investigate the drivers and barriers of this usage intention for different socio-demographic and lifestyle market segments. Developing knowledge about this adoption intention is important. Due to the innovative character of food products containing Spirulina, it is complicated to identify market opportunities due to the non-availability of market data (Lusk & Hudson, 2004). Investigating the introduction of Spirulina in the food supply chain is also in line with the strategy that the European Union adopted in 2012, innovating for sustainable growth: a bio-economy for Europe (EC, 2012). Since functional foods should demonstrate their effects in amounts that can normally be expected to be consumed in the daily diet, they should be integrated in normal food products and not only in pills and food supplements (Martirosyan et al, 2015). Importantly, although functional food usage (intention) has been studied before, previous research shows that the drivers and barriers towards adoption may be often specific product-dependent (de Jong et al., 2003). In the present study we focus on the way Spirulina can gain market entrance as an addition to normal food.

We study the drivers of Spirulina usage intention in food products by means of a quantitative study in Flanders, the Dutch-speaking part of Belgium. Consumers in Belgium have the largest ecological footprint of all Europeans (7.11 global hectares/person) (Global footprint Network, 2011). More specifically, we explore the following research questions:

- To what extent do different socio-demographic and lifestyle consumer segments have a different usage intention towards food products containing Spirulina?
- What is the relative importance of different drivers of and barriers to the usage intention of food products containing Spirulina?
- Is this relative importance different for different socio-demographic and lifestyle groups?

2. Literature review, research questions and hypotheses

The first research question focuses upon differences in the usage intention of food containing Spirulina between socio-demographic and lifestyle groups.

2.1. Socio-demographic characteristics

Gender

Females are considered the most likely buyers of groceries. They are therefore usually more aware of novel foods appearing in the market, such as novel functional foods (Childs and Poryzees, 1998; Gilbert, 1998). Moreover, women are better informed about food and health

related issues and they seem to have more moral and ecological concerns about eating certain foods. They are more open to try out novel food compared to men being more traditional and less critical in their food choices (Beardsworth and Keil, 2002; Gilbert, 1998; Kubberod et al., 2002; Verbeke and Vackier, 2004). We expect:

H1: Females have a higher usage intention with respect to functional foods containing Spirulina than men.

Age

Spirulina may be especially beneficial for older people with increasing health complaints. The high degree of proteins in Spirulina prevents muscle deterioration, but also the high degree of antioxidants is especially beneficial for this age group. A quantitative study by IFIC (1999) reported that consumers aged 45–74 are most likely to adopt functional foods. In the US, Gilbert (1998) reported a higher proportion of 55+ aged among the functional food adopters, which was later confirmed by IFIC (2002). However, age is also often reported as being negatively correlated with the adoption of novel foods. Older people are likely to adhere to their food habits and are more reluctant to try new foods. Moreover, they are likely to adhere more to tasty foods. There is a much broader food selection today than several decades ago. Therefore, in general, younger people have been exposed at early age to exotic foods compared to older people. Therefore, they are more open to trying novel foods products (Fernández-Ruiz et al., 2013, King and Meiselman, 2010; Pliner and Hobden, 1992). Since previous research is inconclusive with respect to the relationship between age and the adoption of novel food, we posit the following research question:

RQ1. What is the relationship between age and the usage intention of functional foods containing Spirulina?

Education

Earlier studies by Gilbert (1998) and IFIC (1999) reported that college graduates are a potential segment for functional food adoption. Higher education could lead to increasing knowledge and interest in food attributes. Higher educated individuals might be better informed about health issues and they may be more aware of the impact of functional food on their personal health and therefore be more prepared to use functional food. Moreover, the willingness to try novel food products increases with higher levels of education (Hursti and Sjoden, 1997). However, previous studies report both a positive (Childs, 1997; IFIC, 1999), negative (Poulsen, 1999), insignificant (Verbeke, 2005), or specific product-dependent (de Jong et al., 2003) association between education and functional food acceptance or use. Therefore we posit the following research question:

RQ2. What is the relationship between the level of education and the usage intention of functional foods containing Spirulina?

Income

Hilliam (1996) posited that higher socio-economic groups are more willing to adopt functional foods, due to the premium price of this product category. Also, the willingness to try novel food products increases with income (King and Meiselman, 2010). We expect:

H2: Individuals with a higher income have a higher usage intention with respect to functional foods containing Spirulina than individuals with a lower income.

Residence

Compared to rural areas, in cities, food availability is much broader. People in rural areas may be less exposed to novel foods and may have a lower willingness to try novel food. Because people living in cities are more confronted with novel products and cities are more often used to try out novel food introductions, city residents may be more familiar with novel food and might have more knowledge of the benefits of functional food. Results in line with this hypothesis have been observed in previous research (Flight et al., 2003 and Tuorila et al., 2001). We expect:

H3: Individuals living in city centers have a higher usage intention with respect to functional foods containing Spirulina than individuals living outside city centers.

Children living at home

A study by Verbeke (2005) revealed that the presence of young children in the household affects food choices, due to the fact that parenting initiates a focus on nutritional benefits (Childs, 1997, Gilbert, 2000). Having children is also associated with higher food risk aversion or higher quality consciousness (Verbeke, Ward, & Viaene, 2000). Since food containing Spirulina may taste differently on the one hand, but is healthy on the other, the effect of the presence of children on the willingness to use Spirulina food is unclear. We formulate the following research question:

RQ3. What is the difference in usage intention of functional foods containing Spirulina between individuals with and without children living at home?

Cooking frequency

People who prepare meals on a frequent basis are usually more concerned with the ingredients they use. This already starts in the shopping phase. People cooking regularly will also try to seek for variation in their recipes, and are expected to be more open to novel foods. We expect:

H4: Individuals who cook more frequently at home have a higher usage intention with respect to functional foods containing Spirulina than individuals who cook less at home.

2.2.Lifestyle

An exploratory qualitative study was conducted to provide insights into promising market segments for this novel product category. First a workshop took place with 10 respondents that were experts in novel food market introductions, owners and marketing managers of food companies, health consultants and special diet experts. This resulted in the creation of well-defined personas (personality and lifestyle descriptions of possible typical users for this novel product): the sporting individual, the vegetarian, the foody, and the needy. The sporting individual was selected due to the high level of proteins in Spirulina that are beneficial for the protection of the muscles. The vegetarian was selected because Spirulina contains proteins as well as vitamins that lack in a vegetarian diet (D, B12). The foody, a person strongly involved in novel food and well informed about what's going on in the food sector, was selected because of the novelty of Spirulina in food. Older people and other people suffering from health complaints (needy) were selected because of the high proteins and the high level of

antioxidants in Spirulina. Additionally, the active enjoyer of life, someone who prefers taste and hedonic value above functional characteristics of food, was selected as a contrast to these groups. We expect that these enjoyers of life will be less inclined to adopt Spirulina in food. Also the needy may be less interested in this novel product, because it is not really a priority for them. We expect the following:

H5. Sporting individuals, vegetarians and foodies have a higher usage intention with respect to functional foods containing Spirulina than life enjoyers and needy people.

In a second qualitative phase, in-depth interviews were conducted with respondents that belong to each of these segments (8 to 10 per segment) and with food experts with respect to each segment (2 per segment). This qualitative study provided insight in the possible drivers and barriers to Spirulina food adoption to be included in the quantitative study (see hereafter).

2.3. Drivers of and barriers to the usage intention of food containing Spirulina

The second research question focuses on possible drivers and barriers with respect to the adoption intention of food containing Spirulina. Based on previous research and insights from the qualitative study, we consider nine possible factors that may influence usage intention. Three of them are health-related: *health consciousness*, *a healthy lifestyle*, and *control over health*. Since Spirulina claims to be an environmental friendly replacement for meat products, *environmental concern* is also taken into account as a driver of usage intention. Spirulina is a novel food attribute that has its benefits, but on the other hand, it has a specific pigment and taste that may have an influence on the sensory appeal of the end product. Therefore, *neophobia for food*, as well as *the importance of good taste* and the *willingness to compromise on taste*, are included. Adding Spirulina in food products is rather new, but Spirulina has been on the market for a while as a food supplement. *Familiarity with Spirulina* may affect the willingness to try products including this ingredient. *Food involvement* was not often specifically researched for functional food adoption, but will be included in our research as well.

Health consciousness

Most theoretical models consider the motivation to prevent disease or improve health as the primary cause of health behavior (Newsom et al., 2005). Health-conscious consumers are aware of and concerned about their wellness, are motivated to improve and/or maintain their health and quality of life, to prevent health deterioration, by engaging in healthy behaviors and being self-conscious regarding health (Newsom et al., 2005; Kraft and Goodell, 1993; Plank and Gould, 1990; Gould, 1988). Health-conscious consumers relate food to health (Wandeland Fagerli, 1999; Rozin et al., 1999) and healthiness has an impact on their decision to buy or avoid food products (Magnusson et al., 2001; Wandeland Bugge, 1997). A higher degree of an individual's health consciousness is related to a more positive attitude toward functional foods (Landström et al., 2007; Naylor et al., 2009). Thus, we expect the following:

H6: A higher degree of health consciousness leads to a higher adoption intention of functional food containing Spirulina.

Healthy lifestyle

The 'lifestyle' construct is related to how people seek to express their identity in domains such as activities, interests, and opinions (Wells & Tigert, 1971; van Raaij & Verhallen, 1994).

Lifestyle factors have long been connected to consumers' food decisions (Senauer et al., 1991). In the health area, Gil et al. (2000) proposed a definition of a healthy lifestyle including health-related activities such as natural food consumption, health care, and life equilibrium. Amongst others, people can try to maintain a healthy lifestyle by choosing healthy food products, such as functional foods. We expect:

H7: A more healthy lifestyle leads to a higher adoption intention of functional food containing Spirulina.

Control over health

Trying to get control over one's health can be manifested in two ways (Matarazzo, 1984). One way is to get control over behavioral pathogens (health impairing habits). The other one is engaging in health protective actions. People perceive themselves to be able to control their behavior are willing to take action. This 'perceived behavior control' (Ajzen, 2002) is also defined as perceived self-efficacy, which is people's beliefs in their ability to influence events that affect their lives (Bandura, 2006). Unless people believe they can produce desired effects by their actions, they have little incentive to undertake activities or to persevere in the face of difficulties. Whatever other factors may serve as guides and motivators, they are rooted in the core belief that one can make a difference by one's actions. In the current context, when the individual is aware of his or her responsibility for controlling his or her own health, this will show in actions or the refusal to act in a certain way. Research has shown that an individual's perception of control over their health positively influences their engagement in health related behavior, such as the intake of sodium (Cox et al., 2004). According to Pferdekamper (2003), preventive health behavior with the goal to gain control over one's health has a positive effect on the adoption of functional food. Hence, we expect:

H8: A higher belief in health control leads to a higher adoption intention of functional food containing Spirulina.

Environmental concern

Attitudes towards the environment or environmental values can be powerful predictors of consumers' action to protect the environment (Kaiser et al., 1999). Bamberg and Möser (2007) showed that the degree of environmental concern can have a direct and strong impact on people's behaviour in specific environment-related domains such as buying environmentally friendly products. To achieve more sustainability, consumers should adopt more sustainable food choices, such as the reduction of meat consumption, since this has a huge impact on Greenhouse gas emissions (WWF, 2012, Garnett, 2011). Recent studies show a trend of ecological concern in relation to the reduction of meat consumption in favour of alternative products. These studies focus on the switch to vegetarian diets and more sustainable food consumption (e.g., Hoek et al., 2011, Ruby and Heine, 2011, Schösler et al., 2012, Tobler et al., 2011, Vermeir and Verbeke, 2008). Spirulina might offer an ecological alternative for including proteins in a diet that is aimed at reducing meat consumption. However, there is another stream of research that has found that pro-environmental products are often not purchased because of pro-environmental motives (Barr, 2004), and therefore there may be only a weak or no relationship between environmental concern and functional food buying (Bamberg, 2003). Therefore we posit the following research question:

RQ4. Does a higher environmental concern lead to a higher adoption intention of functional food containing Spirulina?

Neophobia for food

Human beings are omnivorous animals, suffering from the omnivore's dilemma (Rozin, 1977). This means that people are on the one hand reluctant to eat or avoid novel foods. This is an adaptive value that serves as a protection toward a possible hostile food environment. At the same time, in order to capitalize on the advantages of being omnivorous, one must also be willing to try novel foods (Pliner and Hobden, 1992). Many factors determine whether the conflict will be resolved in favor of approach or avoidance at any particular time and in the presence of any particular food. Tuorila et al. (2001) suggest that food neophobia is an individual trait and accounts for a reluctance to choose new or unusual foods, independent of an individual's own culture. Research reports that food neophobia seems to be an important predictor of people's willingness to try non-traditional ethnic foods (Choe and Cho, 2011, D'antuono and Bignami, 2012). Neophobics are less likely to be interested in ethnic foods compared with neophilics. Food neophobia seems important for only some new food products. For example, food neophobia is not a significant predictor of people's willingness to try genetically modified foods or organic foods (Backstrom et al., 2004). On the other hand, for functional food products, food neophobia has been shown to have a negative impact on consumers' adoption intention (Siegrist, 2008 and Urala and Lahteenmaki, 2007). We expect:

H9. A higher degree of food Neophobia has a negative influence on the adoption of functional food containing Spirulina.

Taste

Food choice is strongly driven by sensory liking, which often overrules the influence of other motivations (e.g., health and environmental concern) (Knaapila et al, 2007; Steptoe et al., 1995). For that reason, sensory liking is often the focus of studies on food acceptance (Resurreccion, 2007). Grunert (2010) identified taste as one of the most important drivers for accepting functional food. Several studies revealed that rational arguments are not always convincing in the adoption process of functional and healthy foods, if the taste of the food is not expected to be good (Tan, Fisher & van Trijp, 2016, Verbeke, 2006). Longitudinal research in Belgium on the acceptance of functional food depending on whether or not it is expected to taste good or bad (Verbeke 2005) concluded that the Belgian consumer was growing more skeptical towards the concept of functional foods in general. This critical attitude is translated into a lower willingness to compromise on taste for health in the case of functional foods. People may differ in their degree to compromise on taste for the expected benefits of functional food. Spirulina has the disadvantage of having a specific sensory appeal as its strong pigments affect the color of food and its strong taste is not always disguisable into the food product it is added to. It may be expected that both the willingness to only accept functional food if it tastes good, as the willingness to compromise on taste for the expected benefits of functional food influences usage intention:

H10. The willingness to adopt functional food containing Spirulina is positively influenced by (a) the willingness to accept functional food only when it tastes good and (b) the willingness to compromise on taste.

Familiarity with Spirulina

Knowledge or experience with a product or a product category are considered an important driver for using a product. Also for food products, familiarity is considered an important

driver for use. It reduces product uncertainty and it initiates a match between expectations and product characteristics (Deliza et al., 1996 and Tuorila et al., 1994). It lowers risk perception and reduces concern about possible negative effects of the products, and it has a negative effect on consumer skepticism (Verbeke et al., 2009). Functional food containing Spirulina is new on the market. But Spirulina is already on the market as a food supplement or a pill. Therefore, familiarity with Spirulina may positively influence the willingness to adopt functional food containing Spirulina. We expect:

H11. Having used Spirulina or algae in the past knowing the product has a positive effect on the adoption intention of functional food containing Spirulina.

Food involvement

Food involvement is the importance one attaches to food, and it is operationalized as the extent to which people enjoy talking about food, think about food during the day, and engage in food-related activities all along the five phases of ‘the life cycle of food’ (acquisition–preparation–cooking–eating–disposal) (Bell & Marshall, 2003). Marshall and Bell (2004) suggest that food involvement appears to influence food choices and food choice patterns. Bell and Marshall (2003) found that people scoring high on food involvement are able to make finer discriminations between food items in their sensory (taste) evaluations and hedonic ratings. They are choosing more healthy food and less unhealthy alternatives (e.g., a higher energy intake from fruit and vegetables, and a lower from fat and snacks) (Marshall and Bell, 2004). Higher food involved people may have a higher interest in novel healthy food as they are more aware of food and devote more attention to food related stimuli. We may assume that also with regard to novel food products containing Spirulina, high food involvement may be a driver for adoption.

H12. A higher degree of food involvement leads to a higher usage intention of functional food containing Spirulina.

Finally, we explore the differences between socio-demographic and lifestyle segments in terms of the relative importance of these drivers and barriers:

RQ5. Is the relative importance of drivers and barriers towards the adoption of functional food containing Spirulina different for different socio-demographic and lifestyle groups?

3. Method

3.1. Procedure and sample

In March 2016, an online survey was sent out to snowball samples of individuals belonging to three lifestyle groups, previously identified as potential target markets for functional food containing Spirulina: sporting individuals, vegetarians, and foodies, and to a group of enjoyers of life. To obtain a sample of needy people, the paper-and-pencil method was used. The snowball sample started with the identification of 8 persons belonging to either lifestyle segment. They were asked to fill out the questionnaire and send it to people they might know with a number of characteristics: how frequently they exercise, being vegetarian, knowing a lot about the latest food trends, liking to eat and drink, being in need of some help. They were all asked to participate in a study about a novel food, assuring their anonymity.

First, questions about cooking habits were asked, followed by questions that measure the health constructs, neophobia, ecological concern, food involvement, and the extent to which good taste is important to them and whether they would sacrifice good taste for the benefits of functional food. Next, familiarity with Spirulina was measured. After a description of food containing Spirulina, the adoption intention toward that product was measured. The questionnaire ended with socio-demographic and lifestyle questions. A total of 1589 respondents fully or partly filled out the questionnaire. Due to respondents dropping out during the completion of the survey, some of the analyses are based on a smaller sample. The regression analyses reported below are based on 1403 respondents. The composition of the sample can be found in Table 1.

3.2. Measures

Most of the constructs under study are based on existing scales. The constructs, their items, all measured on 7-point Likert scales, and Cronbach alphas are reported in Appendix. The dependent variable ‘adoption intention’ was based on Moons and De Pelsmacker (2012). Three health-related constructs were used: health consciousness (Oude Ophuis 1989), healthy lifestyle (Gil et al., 2000), and two items of Wallston et al.’s (1976) health control scale. To measure environmental concern, the widely used New Environmental Paradigm (NEP) Scale was used (Dunlap et al., 2008). Food neophobia was measured using six items selected from the food neophobia scale developed by [Pliner and Hobden \(1992\)](#). Acceptance of functional foods related to taste, was measured by means of two items (Verbeke, 2004): “I accept functional foods if they taste good” and “I accept functional foods even if they taste worse than conventional substitute foods”. The latter item is considered as a measure of consumer willingness to compromise on taste when choosing for functional foods. Familiarity with Spirulina was measured on two levels. The first questions related to the broader product category ‘algues’ and the second part of the questions related to the more specific product ‘Spirulina’. Respondents could categorize themselves in one of 4 categories: I’ve heard about it and used it several times, I’ve heard about it and used it once, I’ve heard about it but didn’t use it, I’ve never heard about it. These answers were recoded into two categories: people that have at least used Spirulina once on the one hand, and people who only heard about it or don’t know it at all. Food involvement was measured by means of an adaptation of the Food Involvement Scale (Bell and Marshall, 2003).

Age (18-29, 30-55, 56 and older), residence (city center, suburbs, countryside) and cooking frequency (every day, at least once a week, less than once a week) were measured in three categories. Gender (male-female), level of education (high school – higher education), income (average or below average – above average), and children at home or not, were measured in two categories. Lifestyle groups were formed on the basis of a question by means of which people had to choose one of the groups that best described their lifestyle (sporting individuals, vegetarians, foodies, life enjoyers, or needy).

4. Results

Two types of analyses were carried out. In the first analyses, the Spirulina usage intention was compared for various demographic and lifestyle groups, by means of ANOVAs and t-tests. The results of these analyses are shown in Table 1. In a second set of analyses, by means of regression analyses, the determining variables of Spirulina usage intention are explored for the full sample and for each of these demographic and lifestyle groups. These results can be found in Table 2.

The Spirulina usage intention is significantly higher for women than for men, in support of H1. This intention is also significantly higher for 30-55 year olds than for younger or older people. In response to RQ1, middle-aged to older people have a higher adoption intention than young people, as partly expected, but in the oldest age category, the usage intention drops again, as also anticipated. The more often people cook, the higher their intention to use Spirulina in food. This result supports H4. Sporting people, vegetarians and foodies have a significantly higher intention to use Spirulina than life enjoyers and the needy. Foodies also have a higher usage intention than sporting people. This supports H5. Contrary to expectations, the level of income and the place where people live do not lead to differences in usage intention. In response to RQ2 and RQ3, the level of education and whether or not people have children living at home, do not have a significant impact on their Spirulina usage intention.

In general, the market segments that seem most ready to use Spirulina in food are middle-aged women who are very much into food and often cook themselves, as well as vegetarians and, to a lesser extent, sporting people.

Table 2 gives the results of a number of regression analyses in which the intention to use Spirulina in food is explained by health consciousness (Hcons), having a healthy lifestyle (HealthyLS), health control (Healthcontr), ecological concern (Ecoconcern), Neophobia, the extent to which they want to consider functional food if taste is good (Tastes good), the extent to which they want to consider functional food even if taste is less good (Tastes less), Familiarity with Spirulina, and food involvement (Foodinv). The correlation between all these variables is less than .500, and multicollinearity is not a problem. First, the model is estimated for the whole sample (all respondents). Subsequently, the model is estimated per socio-demographic category and per lifestyle group.

The results for the full sample show that being familiar with Spirulina and the willingness to use it even if the food then tastes less good are the two most important drivers of usage intention. The significance of these variables supports H11 and H10b. Health consciousness and striving for a healthy lifestyle are also significant drivers of usage intention, in support of H6 and H7. Neophobia has a significantly negative effect on usage intention, consistent with H9. However, contrary to expectations, a number of variables do not have a significant effect on usage intention: to desire to control one's health, the opinion that one wants to use Spirulina only when it tastes good, and food involvement, rejecting H8, H10a and H12, respectively. In response to RQ4, ecological concern does not have an effect on usage intention.

In response to RQ5, most of these effects are similar in the majority of the socio-demographic and lifestyle groups. Apparently, usage intention is driven by health concern and healthy lifestyle, familiarity with the product, and the willingness to give up good taste. Neophobia hampers usage intention. Nevertheless, there are some interesting differences between groups. Compared to men, women are more driven by familiarity and good taste, and less by neophobia. With respect to age groups, there is an interesting pattern in terms of the relative importance of the drivers of usage intention. Although health concern, the willingness to give up good taste and Spirulina familiarity are significant determinants of usage intention in all three age groups, their importance decreases with age. On the other hand, neophobia is a significantly negative driver of usage intention, but its importance increases with age. The willingness to try Spirulina only if the food tastes good is a significant driver of usage intention only in the middle age group. Compared to lowly educated individuals, highly

Table 1. Intention to use Spirulina in food: descriptives and comparisons between groups

	Mean	S.D.	N	Sign.
Gender				
Male	3.433	1.434	691	<.001
Female	3.628	1.575	898	
Age				<.001
18-29	3.471	1.409	502	30-55 > 18-29 (.011) 30-55 > 55+ (<.001)
30-55	3.741	1.533	569	
>55	3.276	1.577	518	
Education				
High school	3.461	1.567	518	>.05
Higher	3.525	1.498	1071	
Income				
Low	3.481	1.524	928	>.05
High	3.539	1.524	638	
Residence				
City center	3.544	1.475	560	>.05
Suburbs	3.488	1.532	597	
Countryside	3.475	1.566	432	
Children at home				
No	3.542	1.458	605	>.05
Yes	3.480	1.559	984	
Cooking frequency				<.001
Every day	3.0679	1.580	842	Every day > at least once a week (.004) Every day > less than once a week (<.001) At least once a week > less (.016)
At least once a week	6.410	1.442	515	
Less than once a week	3.076	1.368	232	
Lifestyle				<.001
Sporting	3.630	1.363	227	Sporting > enjoyer (.004) Sporting > needy (.006) Veggy> enjoyer (<.001) Veggy> needy (<.001) Foody > enjoyer (<.001) Foody > needy (<.001) Foody > sporting (.009)
Vegetarian	3.763	1.580	274	
Foody	4.076	1.523	273	
Enjoyer of life	3.223	1.471	684	
Needy	3.039	1.484	110	

Significance levels refer to t-tests or f-tests and to Bonferroni-corrected post-hoc tests

educated ones are more driven by the willingness to have a healthy lifestyle and by familiarity, and less by neophobia. Low income individuals are more driven by neophobia and health concern than high income people, while the latter are more affected by familiarity with Spirulina. With respect to where people live, the results show that health concern is not a significant driver of usage intention for people living in the suburbs. A healthy lifestyle is not significant in the countryside, and neophobia is not significant for people who live in the city center. Compared with families without children, families with kids at home are more strongly driven by neophobia and the willingness to give up good taste. Familiarity with Spirulina and the willingness to give up good taste are more important drivers, and

neophobia is a less important driver of usage intention, the more people cook at home. Contrary to people who cook more frequently, a healthy lifestyle is not a significant driver for people who cook at home less than once a week.

A number of remarkable differences between some of the lifestyle groups appear. The usage intention of sporting people and vegetarians are mainly influenced by familiarity and the willingness to give up good taste. The same goes for the enjoyers, but the latter are also driven by health concern (be it less than by familiarity and taste considerations). The foodies have a substantially different motivational pattern. Their main driver is health concern, followed by striving for a healthy lifestyle, familiarity with Spirulina and the willingness to give up good taste. Neophobia has a significant negative effect upon their usage intention. Surprisingly, the more they want to be in control of their health, the more negative their adoption intention becomes. The needy are negatively influenced by neophobia and positively by the importance they attach to good taste.

Table 2a. Regression analyses results, dependent variable: intention to use Spirulina in food (all respondents, gender, age and education groups)

Group	All	Gender		Age			Education	
		Male	Female	18-29	30-55	>55	Low	High
Hcons	.144 ($<.001$)	.146 (.006)	.133 (.004)	.181 (.005)	.153 (.007)	.124 (.024)	.125 (.049)	.152 ($<.001$)
Healthy LS	.100 (.002)	.084 (.073)	.110 (.010)	.089 (.113)	.089 (.087)	.086 (.284)	.049 (.392)	.126 (.001)
Health contr	.011 (.724)	-.024 (.623)	.050 (.210)	.001 (.990)	.036 (.479)	-.001 (.979)	.027 (.616)	.010 (.787)
Ecoconcern	.011 (.660)	.002 (.955)	.021 (.517)	-.067 (.138)	.079 (.051)	-.006 (.896)	.074 (.083)	-.027 (.374)
Neophobia	-.110 ($<.001$)	-.145 (.001)	-.090 (.008)	-.053 (.266)	-.099 (.023)	-.141 (.002)	-.159 ($<.001$)	-.092 (.003)
Familiarity	.188 ($<.001$)	.115 (.002)	.220 ($<.001$)	.198 ($<.001$)	.220 ($<.001$)	.102 (.022)	.116 (.008)	.220 ($<.001$)
Foodinv	.056 (.052)	.076 (.097)	.029 (.425)	-.011 (.839)	.060 (.209)	.099 (.052)	.085 (.095)	.038 (.273)
Tastes good	.037 (.122)	-.023 (.599)	.082 (.012)	.039 (.372)	.086 (.032)	-.015 (.725)	.088 (.037)	.002 (.935)
Tastes less	.196 ($<.001$)	.191 ($<.001$)	.193 ($<.001$)	.114 (.013)	.188 ($<.001$)	.263 ($<.001$)	.218 ($<.001$)	.189 ($<.001$)
R²	.216	.173	.245	.152	.266	.217	.233	.224

Cells are Beta-coefficients and their significance level.

Chow test significance levels are based on F-tests

Table 2b. Regression analyses results, dependent variable: intention to use Spirulina in food (income, dwelling and children at home groups)

Group	Income		Dwelling			Children	
	Low	High	City	Suburbs	Country	No	Yes
Hcons	.191 ($<.001$)	.090 (.098)	.189 (.001)	.061 (.291)	.195 (.006)	.143 (.015)	.148 (.001)
Healthy LS	.092 (.032)	.104 (.033)	.116 (.028)	.124 (.019)	.048 (.444)	.085 (.099)	.117 (.004)
Health contr	-.032 (.426)	.085 (.079)	.002 (.967)	.004 (.938)	.033 (.594)	.001 (.994)	.018 (.634)
Ecoconcern	-.002 (.945)	.008 (.833)	-.047 (.266)	.064 (.118)	.002 (.966)	.005 (.893)	.009 (.770)
Neophobia	-.139 ($<.001$)	-.085 (.036)	-.053 (.238)	-.150 ($<.001$)	-.114 (.021)	-.053 (.224)	-.139 ($<.001$)
Familiarity	.160 ($<.001$)	.221 ($<.001$)	.162 ($<.001$)	.190 ($<.001$)	.222 ($<.001$)	.211 ($<.001$)	.172 ($<.001$)
Food inv	.073 (.057)	.037 (.408)	.068 (.165)	.008 (.860)	.110 (.047)	.080 (.096)	.041 (.249)
Tastes good	.029 (.362)	.052 (.172)	.069 (.094)	-.005 (.893)	.061 (.194)	.091 (.022)	.009 (.773)
Tastes less	.199 ($<.001$)	.189 ($<.001$)	.170 ($<.001$)	.244 ($<.001$)	.170 ($<.001$)	.153 ($<.001$)	.215 ($<.001$)
R²	.228	.217	.188	.225	.266	.191	.240

Cells are Beta-coefficients and their significance level

Chow test significance levels are based on F-tests

Table 2c. Regression analyses results, dependent variable: intention to use Spirulina in food (cooking habits and lifestyle groups)

Group	Cooking			Sporting	Vegetarian	Foody	Enjoyer	Needy
	Daily	1/week	$<1/week$					
Hcons	.096 (.048)	.221 ($<.001$)	.152 (.088)	.119 (.219)	.091 (.284)	.308 ($<.001$)	.108 (.043)	.027 (.836)
Healthy LS	.100 (.024)	.115 (.035)	.035 (.668)	.097 (.269)	.122 (.106)	.194 (.012)	.051 (.300)	.001 (.994)
Health contr	.041 (.325)	-.088 (.103)	.094 (.268)	.032 (.706)	.130 (.093)	-.168 (.024)	-.002 (.970)	.097 (.399)
Ecoconcern	.041 (.233)	-.034 (.438)	-.017 (.809)	-.006 (.929)	-.089 (.150)	-.006 (.915)	.025 (.738)	.094 (.350)
Neophobia	-.095 (.007)	-.133 (.004)	-.146 (.074)	-.082 (.261)	-.051 (.425)	-.147 (.014)	-.080 (.061)	-.299 (.007)
Knowledge	.208 ($<.001$)	.163 ($<.001$)	.048 (.492)	.190 (.007)	.190 (.002)	.231 ($<.001$)	.147 ($<.001$)	.042 (.689)
Food inv	.049 (.187)	.031 (.526)	-.024 (.783)	.026 (.749)	.062 (.382)	.001 (.986)	.075 (.105)	.110 (.339)
Tastes good	.007 (.835)	.090 (.038)	.078 (.271)	.115 (.097)	.051 (.390)	-.006 (.912)	-.028 (.480)	.273 (.013)
Tastes less	.258 ($<.001$)	.136 (.002)	.124 (.088)	.167 (.015)	.104 (.095)	.238 ($<.001$)	.225 ($<.001$)	.121 (.259)
R²	.241	.188	.122	.172	.208	.319	.139	.283

Cells are Beta-coefficients and their significance level

Chow test significance levels are based on F-tests

5. Conclusions, implications, and further research

Overall, the highest readiness to use Spirulina in food can be found in middle-aged women who are very much into food and often cook themselves, as well as in vegetarians and, to a lesser extent, sporting people. This is partly in line with earlier research on gender differences (Beardsworth and Keil, 2002; Gilbert, 1998; Kubberod et al., 2002; Verbeke and Vackier, 2004) and age differences (IFIC, 1999). The results also support the findings of the qualitative study: focusing on foodies, vegetarians and to some extent sporting people is the most promising targeting approach. In general, people are more motivated to use Spirulina in food when they are more familiar with the algae, and when they are more ready to give up good taste. This is in line with findings from earlier research that claim familiarity as being an important food choice motive. (Deliza and MacFie, 1996; Tuorila et al., 1994, Verbeke et al., 2009). Also the finding that health concerns are important drivers of usage intention is in line with earlier research (Di Pasquale et al., 2011, Berrana and Sanchez, 2013, Bech-Larsen and Grunert, 2003). However, the effect of the belief in one's own impact on personal health (Hilliam, 1996) was not found in the current study. In line with previous research, neophobia has a negative effect on usage intention (Siegrist et al., 2008; Urala and Lahteenmaki, 2007).

Ecological concern does not affect usage intention. Also Bamberg (2003) reported only a low to moderate association between consumers' concern about the environment and the adoption of consumption behaviour that was considered to be environmentally friendly. Apparently, there are other reasons behind adopting 'greener' products. One of the reasons consumers choose not to adopt environmentally friendly products, even if they want to help the environment, is lack of efficacy. Essentially, this is the idea that one person is not going to make enough of a difference, so why bother? Kinnear et al. (1974) referred to this phenomenon as *perceived consumer effectiveness* (PCE). Considerations of good taste generally do not affect usage intentions. This is opposite to increasing importance of taste over time, as reported in the longitudinal study of Verbeke (2005).

Marketers of Spirulina who want to target the market segments that have the highest willingness to adopt Spirulina should pay particular attention to the relative importance of some of these drivers in these market segments. To appeal to women, making them as familiar with Spirulina as possible is imperative, and, contrary to the results in other groups, they are also driven by the good taste of food products. On the other hand, neophobia, although significant, does not influence their usage intention too much. As in almost all groups, health considerations are also important. Another promising segment is the middle age group. In this group, the general drivers of usage intention are important: health concern, familiarity with Spirulina, and the willingness to give up good taste. However, also in this group the consideration of good taste is important. For people who are a lot into food and cook a lot at home, another important market segment, also health concerns, familiarity with the product, the willingness to give up good taste, and neophobia are the most important drivers of usage intention. Vegetarians are mainly driven by familiarity with the product and the willingness to give up good taste.

Further research could focus on specific motivations with regard to food choices, and their relative importance for Spirulina food adoption intention. Future research could also focus on specific food products that Spirulina can be added to. On the one hand, the familiarity with these products can positively spill over to the same products containing Spirulina. On the other hand, adding Spirulina may make these food products more or less attractive, depending on the type of products (e.g., desserts versus salads). The study should also be replicated in other countries to corroborate our findings.

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Appendix

	Mean	SD	Cronbach alfa
Adoption intention	3.504	1.521	0.938
I have the intention to use foods including Spirulina in the near future			
I will recommend the use of foods containing Spirulina			
I have the intention to use foods containing spirulina on a regular basis			
Healthy lifestyle	4.369	0.907	0.719
I exerciseregularly			
I avoid eating processed food			
I often eat fruits and vegetables			
I rarely eat red meat			
I avoid eating food products with additives			
I take regular health check-ups			
I try to reduce my stress			
I try to have an organized and methodical lifestyle			
I try to balance work and personal aspects			
I am vegetarian			
I avoid adding salt			
Health consiousness	4.533	0.908	0.695
I have the impression that I sacrifice a lot for my health			
I consider myself very health conscious			
I am prepared to leave a lot, to eat as healthy as possible			
I think that I take health into account a lot in my life			
I think it is important to know well how to eat healthy			
My health is so valuable to me, that I am prepared to sacrifice many things for it			
I have the impression that other people pay more attention to their health than I do (R)			
I do not continually ask myself whether something is good for me (R)			
I really don't think often about whether everything I do is healthy (R)			
I don't want to ask myself all the time, whether the things I eat are good for me (R)			
I often dwell on my health			
Control over health	5.526	1.063	0.65
Food plays an important role in attaining a good personal health			
I feel that I can take control over my personal health			
Ecological concern	4.883	0.783	0.803
We are approaching the limit of the number of people the Earth can support			
Humans have the right to modify the natural environment to suit their needs			
When humans interfere with nature it often produces disastrous consequences			

Human ingenuity will insure that we do not make the Earth unliveable Humans are seriously abusing the environment The Earth has plenty of natural resources if we just learn how to develop them Plants and animals have as much right as humans to exist The balance of nature is strong enough to cope with the impacts of modern industrial nations Despite our special abilities, humans are still subject to the laws of nature The so-called “ecological crisis” facing humankind has been greatly exaggerated The Earth is like a spaceship with very limited room and resources Humans were meant to rule over the rest of nature The balance of nature is very delicate and easily upset Humans will eventually learn enough about how nature works to be able to control it If things continue on their present course, we will soon experience a major ecological catastrophe			
Food involvement	4.652	0.796	0.725
I don't think about food every day (R)			
I don't really enjoy cooking (R)			
I don't like talking about what I ate or what I'm going to eat (R)			
Regarding the decisions I have to make on a daily basis, those related to food are not important (R)			
When I'm travelling I look forward to what I want to eat			
After making my meals, I usually clean up the preparation space			
Cooking for other people and for myself is something quiet pleasurable, that I love to do.			
When eating outside the home, I don't tend to talk about the taste of the meals (R)			
I don't like mashed or mixed food			
I'm usually responsible for choosing and buying food in my house			
Usually, it is not me washing the dishes used to prepare and consume meals (R)			
For me it is important that the table is well decorated			
Food Neophobia	3.255	1.087	0.821
I am constantly sampling new and different foods (R)			
I don't trust new foods			
If I don't know what is in a food, I won't try it			
At dinner parties, I will try a new food (R)			
I am afraid to eat things I have never had before			
I will eat almost anything (R)			
Tastes good	4.981	1.657	
I accept functional foods if they taste good			
Tastes less	3.090	1.589	
I accept functional foods even if they taste worse than conventional substitute foods			