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Appropriateness, acceptance and sensory preferences based on visual information: A web-based survey on meat substitutes in a meal context

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ABSTRACT

The aim of this study was to investigate the appropriateness, attractiveness, use-intention and (un)desirable sensory properties of meat substitutes in different dishes based only on visual information. A web-based survey was developed to let consumers assess the use of meat substitutes in different dishes. The survey consisted of 38 key questions with subdivisions and was completed by 251 respondents. Six different dishes (spaghetti, rice, wrap, pizza, pasta salad, and soup) were rated for their appropriateness for the use of meat substitutes. Subsequently, appropriateness, attractiveness, and use-intention were rated based on photographs of the six dishes prepared with meat substitutes that differed in shape and appearance. Respondents also had to indicate (un)desirable sensory properties of meat substitutes for every dish. Spaghetti, rice and wrap were more appropriate for the use of meat substitutes than the other dishes. The most appropriate meat substitute–meal combinations were those that are similar to common Dutch meal combinations (e.g. spaghetti with mince and rice with pieces). Attractiveness and intention scores were in line with the appropriateness scores. Furthermore, we found that current users of meat substitutes and younger respondents gave higher appropriateness ratings. This study demonstrates that appropriateness of meat substitutes in a dish is related to attractiveness and use-intention and that meal context should be taken into account in the development of new meat substitutes.

1. Introduction

Meat is an important protein source in the Western diet. In Asian and African countries daily meat consumption is also becoming more common, and subsequently the global meat production keeps on growing (Aiking, 2011; Smil, 2002). An increasing number of studies and literature indicate that the production of meat is not very efficient regarding the use of land, water and other resources, and the emission of green-house gases (as reviewed in Vinnari & Tapio, 2009 and Aiking, 2011). The combination of increased meat consumption and the environmental impact requires the investigation of alternative protein sources.

Several different types of alternative protein sources have been used to develop new food products that can replace meat in the consumers' meals. Some products have been around for a long time, like tofu, a soy product that originates from Asia. Tofu became popular among vegetarians in the West since the middle of the 20th Century (Courtine, 1984; Shurtleff & Aoyagi, 2014). Current meat substitutes can be made from legumes (such as soy, lentils, (chick) peas or lupins), wheat, rice and egg protein that are ground into meal or processed into protein isolates or protein concentrates (Broekema & Smale, 2011). Besides plant-based meat substitutes, fungus-based products (Quorn®) were introduced in Europe in the 1990ies and the USA in 2002. A newer type of meat alternative is Valess®, a product based on dairy and algae that was introduced in 2005 and is available in several European countries. The use of insects for the development of meat alternatives is being studied as well (Klunder, Wolkers-Rooijackers, Korpela, & Nout, 2012; Rumpold & Schlüter, 2013). The success of new food products depend on their consumer acceptance, which is a result from a combination of taste, familiarity, and whether or not they meet consumers' expectations (van Trijp & van Kleef, 2008; Wansink, 2002). Consumer studies suggested that meat substitutes should either resemble meat or should be products that are very different from meat and have their own distinct identity (Elzerman, van Boekel, & Luning, 2013; Hoek, van Boekel, Voordouw, & Luning, 2011). The problem with meat substitutes that do not resemble meat is that consumers may not recognize them as such and therefore do not purchase them instead of meat. In order to realize the environmental benefits of purchasing meat substitutes, it is

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essential that the substitutes are purchased instead of meat, not as an additional product, thereby diminishing demand for meat products. In The Netherlands, meat is traditionally eaten as a separate meal component, although pasta and rice dishes with meat ingredients in a sauce have also become common (Jobse-van Putten, 1996; Schösler, de Boer, & Boersema, 2012). Due to the different structures of plant proteins and meat proteins, it is not yet feasible to mimic meat chops with plant proteins. Meat substitutes might therefore be more successful as 'ingredients' (in the form of small pieces or mince) in a meal context than as 'separate meal components' (for the replacement of large cuts of meat) (Aiking, 2006).

Previous studies indicate that meal context plays an important role in consumer acceptance of meat substitutes. During focus group discussions consumers indicated that some dishes were more appropriate for the use of meat substitutes than others (Elzerman et al., 2013). A Central Location Test (CLT) showed that consumers gave different ratings to different meat-substitute-meal combinations (Elzerman, Hoek, van Boekel, & Luning, 2011).

Studying meal context rather than testing separate food items is closer to the real life eating situation. However, only a few other studies on the influence of meal context on consumer acceptance have been published. Reasons for this may be the complexity of the design and logistics, together with the fact that in research that is closer to the 'real world' it is more difficult to control the stimulus. It is, however, important to find a balance between control and realism (Meiselman, 2013). Whether or not consumers tested food items separately, rather than as part of a meal influenced the consumer ratings of the food items (King, Meiselman, Hottenstein, Work, & Cronk, 2007; King, Weber, Meiselman, & Nan, 2004). A repeated exposure study showed that meal context was important for the long-term acceptance of meat substitutes (Hoek et al., 2013).

A CLT with hot meals is a very time consuming, expensive and complicated consumer study and the amount of samples that can be tested by participants before they are satiated is limited. For product development of meat substitutes it would be more efficient to assess the appropriateness of meat substitutes in a broad range of dishes and in a large consumer sample before starting a consumer taste test. An Internet survey using photographs of the dishes could be an instrument for appropriateness evaluation, and even photographs of the uncooked meat substitutes could be included to create a more realistic assessment situation for respondents.

The objective of this study was to gain insight into the appropriateness, attractiveness, use-intention and sensory preferences of meat substitutes in different meal contexts based on visual information.

2. Materials and methods

2.1. Subjects

For this survey, we used a non-random convenience sample, aimed to collect data from respondents with various backgrounds in terms of socio-demographics and habitual consumption of meat and meat substitutes in order to compare subgroups. 251 consumers completed the questionnaires, of which 66% were recruited via advertisements on five Internet sites and newspapers and accessed the questionnaire via a web-address. To avoid bias as a result of Internet access or computer skills, a part of the respondents (34%) was recruited in a public library in a city in The Netherlands. Visitors entering the library were randomly approached, and were asked to participate in a questionnaire on meals by Wageningen University. A researcher provided assistance for persons with no or little computer experience. Assistance with completion of the questionnaire was provided to ±20% of the library respondents.

Table 1
Sample characteristics ($N = 251$).

		N	%
Gender	Male	79	31
	Female	172	69
Age	Between 15 and 34	172	69
	Between 35 and 54	42	17
	Between 55 and 79	37	15
Education level[a]	Low	35	14
	Medium	103	41
	High	107	43
	Not indicated/other	6	2
Meat consumption	Never	54	22
	<1× per month	8	3
	1–8× per month	23	9
	2–5× per week	112	45
	6–7× per week	54	21
Meat substitute consumption	Never	44	18
	<1× per month	91	36
	⩾1× per month; <1× per week	63	25
	⩾1× per week	53	21
Recruitment	Online	166	66
	Public library	85	34

[a] Education levels: *Low*: From primary education up to pre-vocational education (Dutch: VMBO, MAVO); *Medium*: Secondary vocational education (Dutch: MBO), senior general secondary education (Dutch: HAVO) and pre-university education (Dutch: VWO); *High*: Higher professional education (Dutch: HBO) and University.

Chi square tests showed that the recruitment method yielded different groups of respondents. Respondents that were recruited in the library were generally older (X^2 (2) = 99.1, $p < 0.001$), were lower educated (X^2 (2) = 53.7, $p < 0.001$), their meat consumption was higher (X^2 (4) = 12.8, $p = 0.012$), and their meat substitute consumption was lower (X^2 (3) = 22.0, $p < 0.001$).

All respondents were living in The Netherlands and their mother tongue was Dutch. The sample characteristics are shown in Table 1.

2.2. Dishes and meat substitutes

Six different types of dishes were selected to study the effect of meal context on the appropriateness and attractiveness of meat substitutes. The dishes differed in their ingredients, their usage, temperature, texture and newness. The dishes included: a main course soup (merely a liquid dish), a pizza (meat substitutes as a topping), spaghetti with tomato sauce (meat substitutes in a sauce), a pasta salad (a chilled dish), rice with curry (meat substitutes in sauce), and a wrap with Mexican filling (a less common of dish in The Netherlands). In this study, the terms dish, meal combination and meal context refer to the type of dish in which a meat substitute can be eaten.

The products that were used were all meat substitute 'ingredients' that can be used in a sauce or in a dish and they were selected based on their differences in appearance in terms of color, shape and size. We gave these meat substitutes different names based on their shape: 'mince' was a granular, dark-brown product, like minced meat; 'strips' were lighter brown with a rectangular shape; 'pieces' had a white color and a more round, irregular form and looked a bit like chicken; 'slices' had a brownish color and looked like pepperoni; 'cubes' were brown with a square/cubic form. The meat substitutes were commercially available in The Netherlands, but there was no reference to brand names of the products in the questionnaire or the origin of the ingredients of the meat substitutes.

2.3. Development of the web-based survey

A web-based survey with descriptions and photographs of dishes with meat substitutes was used to study the appropriateness,