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Attitude of assessors in the Czech Republic to the consumption of house cricket *Acheta domestica* L. – A preliminary study

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Abstract: Sensory acceptability of the consumption of whole baked house crickets by assessors in the Czech Republic was investigated. The main aim was to observe attitudes to eating edible insects before and after their tasting and to assess the extent of the effect of prejudices. Hedonic evaluation of the overall acceptability of edible insects was carried out under laboratory conditions by trained assessors. Of the 98 panellists, 68 were willing to evaluate the sample visually and then by tasting. They showed statistically significant differences ($P < 0.0001$) in overall pleasantness before tasting (40 ± 22%) and after tasting (61 ± 17%). No statistically significant differences between male and female assessors were observed, either before or after tasting. Women and younger assessors were slightly more open to entomophagy, but there were no statistically significant differences between males and females or between the two age categories (18–25 and 26–45 years of age) in the results. The preferred methods of culinary preparation of edible insects that the respondents would choose were baking, roasting and frying.

Keywords: acceptability; edible insects; novel food; sensory analysis

Almost 2 000 insect species have been reported as components of human diet in more than 100 countries, mostly in Africa, Asia and Latin America, where they are considered to be a valuable source of nutrients (Johnson 2010). The consumer population in Europe reacts generally with disgust to the idea of eating insects (Yen 2009; Looy et al. 2014), but the willingness to include insect products in the diet has been reported from North America and Western Europe (Hartmann et al. 2015; Ruby et al. 2015; House 2016). Moreover, a certain shift is EU Regulation 2015/2283 as, since January 2018, edible insects can be considered as novel foods in the EU.

Food intake and rejection are the result of the involvement of sensory-affective functions that relate to sensory properties as well as thoughts relating to the nature and origin of food. There is also a major concern about the safety of food, which is closely linked to physical and mental harm (Rozin & Fallon 1987). The most important measure in determining whether an insect is edible or inedible is its taste, which is very diverse, including flavours akin to hazelnuts, apples, seeds, fish and seafood or bread. The taste of insects relates to the environment in which they occur and the food they eat. It also depends on species, life cycle stage, size and colour (Tan et al. 2015).

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Insects are mostly consumed after some culinary treatment (fried, roasted, mixed into rice, soups, pasta, or salads). The way of killing and cooking also plays a role in nutritional and sensory properties of insects (Farina 2017; Akhtar & Isman 2018). Insects are usually rich in fat which gives the main flavour to many foods. During baking, frying and other culinary processes, fat in insects can undergo oxidation, creating products such as aldehydes and ketones which influence the final taste and smell. The body of the insect has an exoskeleton that gives it crispness. Uncooked edible insects are almost odourless due to the presence of the exoskeleton (Ramos-Elorduy 1998).

Since the attitudes of Czech consumers of edible insects are not much reported, the aim of this work was to determine the sensory acceptability of edible insect samples for a Central European population and to compare their attitudes towards insect consumption with the results of Western European studies where entomophagy is more common. It was also important to observe the attitudes to eating edible insects before and after tasting them and to assess the extent of the effect of prejudices before eating and changes in attitudes after tasting insects. The hypothesis was that the attitude to eating edible insects would be improved after tasting them, and that differences in the acceptability of edible insects depend on the gender and age of the consumer. The house cricket [*Acheta domestica* (Linnaeus, 1758)]. was selected as a model insect. This species is known to be commercially mass-produced for food and feed purposes, even in the Czech Republic.

MATERIAL AND METHODS

House cricket (*A. domestica*) adults were purchased at the Hostivice Pet Food Centre (Václav Donát Company). They were starved for 24 h before being killed by immersion in boiling water and subsequently baked in an oven at 200 °C for 10 minutes. Sensory evaluation was carried out under laboratory conditions (ISO 8589:2007) by trained assessors (ISO 8586:2012); students and staff of the university. Samples of the cooked insects were served in closed Petri dishes.

The evaluation form for sensory analysis was based on a study by Megido et al. (2014). The assessors had to first visually evaluate the overall acceptability of a sample. This was followed by hedonic evaluation of the same descriptor after insect consumption using a 100-mm linear graphically oriented unstructured scale (0% = rejectable, 100% = excellent). Not all assessors were willing to taste the sample, but those who did were also asked to answer the following yes-no questions concerning entomophagy: (1) Were you aware of entomophagy prior to this trial? (2) Are you really interested in eating insects? (3) Do you have a negative feeling toward entomophagy? (4) Are you willing to eat insects in the future? (5) Would you cook insects at home?

The respondents were also asked what cooking method they would use for insects.

A *t*-test for dependent variables was performed, using Statistica 12 software (StatSoft, Inc., USA), to look for statistically significant differences between the evaluation of insects before and after tasting. In addition, ANOVA (analysis of variance) was used to evaluate differences between sensory evaluation before and after tasting in relation to the gender and age of assessors. The chi-square test was applied to determine whether answers to the additional yes-no questions depended on the age category of the assessor. All statistical analyses were performed at the probability level $\alpha = 0.05$. Results are expressed as mean ± standard deviation.

RESULTS AND DISCUSSION

A total of 98 participants took part in sensory analysis; 80 of them were women (Table 1). The results of the visual evaluation of overall acceptability before tasting from all 98 assessors were 34 ± 22%. Of the total number of assessors, 68 were willing to taste the sample and continued with the sensory evaluation. The remaining 30 assessors evaluated the sample only visually and were not willing to taste it. The value of overall pleasantness of the sample (21 ± 14%) was low for this group.

Most important were the results of the hedonic evaluation by those who evaluated the sample visually and then by tasting (Figure 1). They showed statistically significant differences ($P < 0.0001$) in overall pleasantness before tasting (40 ± 22%) and after tasting (61 ± 17%). No statistically significant differences in evaluation between male and female assessors were

Table 1. Representation of men, women and age categories in the panel of assessors

Assessors	Number	Female	Male	Age category	
				A	S
Total	98	80	18	87	11
WD	68	56	12	61	7
NWD	30	24	6	26	4

A – 18–25 years old; S – 26–45 years old; WD – assessors willing to taste the samples; NWD – assessors not willing to taste the samples

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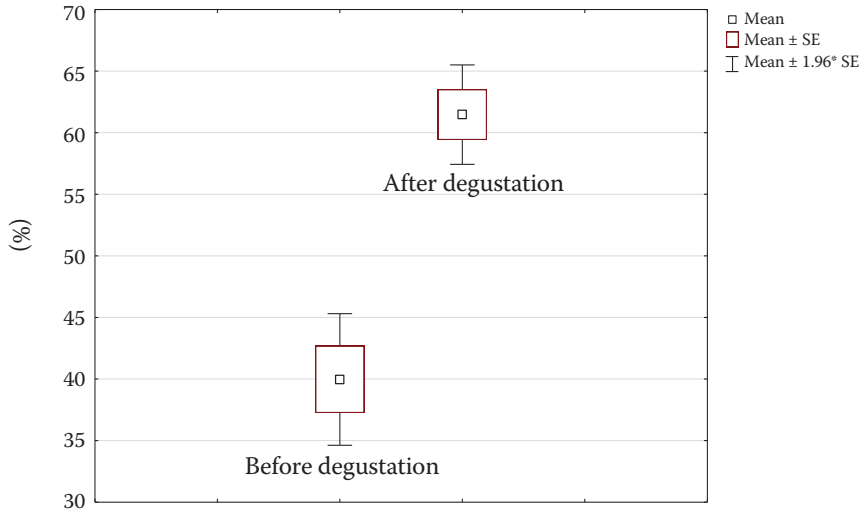

Figure 1. Box plot of *t*-test results from hedonic evaluation of samples before and after degustation

observed, either before (P = 0.5039) or after tasting (P = 0.4081). There was only a slightly higher proportion of women among the panellists who were willing to consume crickets than among those who did not taste the samples (Figures 2 and 3).

According to the study of Megido et al. (2014), our assessors were divided into two age categories: A: 18–25 years old; and S: 26–45 years old. No statistically significant difference was found in the hedonic evaluation between the two age groups before (P = 0.9697) or after tasting (P = 0.9638). The assessors who tasted the sample had only slightly more respondents from age group A (90%) compared to those who were not willing to consume the insects (86% of A group) (Figures 2 and 3).

A chi-square test was performed on the questionnaire answers of the assessors who tasted the sample. The relationship between the age category and the individual answers to the supplementary yes-no questions was examined (Table 2). Only in Question 2 (Are you interested in eating insects?) a statistically significant difference between the younger category A and the older category S was found. The older age category rated this question more negatively than the younger assessors. However, the number of assessors in the given age categories was rather unequal. Of those assessors who answered how they would cook insects at home, 7 said baking in the oven, 5 said roasting on the pan and 5 said deep frying. Shallow frying in garlic, caramel, chocolate and spicy batter was proposed by one assessor.

Köster et al. (2004) reported that a visual stimulus determines taste expectations. According to Yhoungaree (2008) body reaction, taste perception and smell of food can provide valuable information on whether or not it is appropriate to consume a particular food. From the results (Table 1) it can be seen that about one third of the assessors had a problem with the consump-

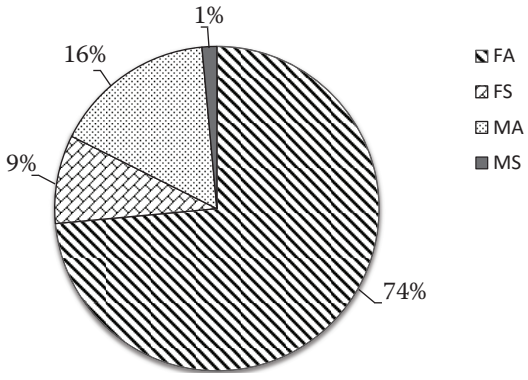

Figure 2. Representation of men, women and age categories among the assessors willing to taste the sample

F – female; M – male; A – 18–25 years old; S – 26–45 years old

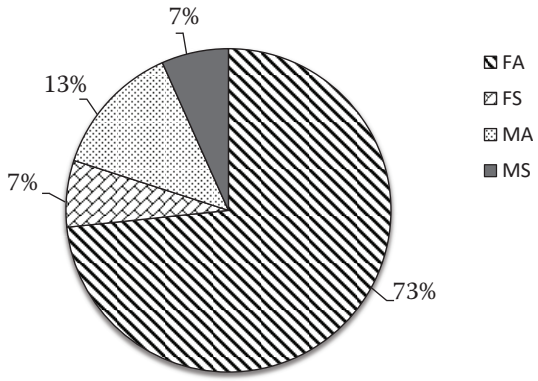

Figure 3. Representation of men, women and age categories among the assessors not willing to taste the samples

F – female; M – male; A – 18–25 years old; S – 26–45 years old

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Table 2. Effect of age on the answers of assessors to yes-no questions

Category	Number of respondents	Questions				
		1	2	3	4	5
Age						
18–25	61	59 (96%)*	26 (43%)	28 (46%)	55 (90%)	42 (69%)
26–45	7	7 (100%)*	6 (86%)	4 (57%)	7 (100%)	5 (71%)
Statistics						
Chi-square	–	0.24	4.68	0.32	0.76	0.02
P-value	–	0.6267	0.0305	0.5725	0.3848	0.8889

*Number (percentage) of answers

tion of insects served as the whole insect. Literature data indicate that well designed products containing invisible insects can not only improve physicochemical and textural properties of products (Kim et al. 2017), but also reduce consumer aversions and increase the acceptance of entomophagy (Tan et al. 2016; Tao & Li 2018). Hartmann et al. (2015) also found that neophobia (fear of anything new) was much more apparent in respondents who had no experience with prior insect consumption (for example, German respondents were more neophobic than Chinese). On the other hand, curiosity was reported to be the most frequent reason why people in Northern Germany want to eat insects (Grabowski et al. 2008).

Megido et al. (2014) stated that fear of insects (entomophobia) in their natural form can induce negative feelings in people when imagining eating of insects. The acceptability of novel foods does not differ according to gender, as reported by Johns et al. (2011), but the study by Tuorila et al. (2001) suggested that men are more neophobic than women. However, according to Schösler et al. (2012), women generally have greater fear of insects than men, which has not been confirmed by our results. Our results on the overall acceptability of whole crickets showed that there were no statistically significant differences between men and women.

The main finding of our study is that, although people visually evaluated the sample of the house crickets quite negatively (women by 6% less than men, and 18–25 year olds by 2% less than 26–45 year olds), their evaluation significantly improved after eating them. Although people usually connect insects with dirt and litter rather than with food (Looy et al. 2014), their assessment was much more positive after tasting the house crickets.

The results of our study on future interest in eating house crickets correspond to the results of Megido et al. (2014), where 81% of respondents aged 19–25 years and 92% of respondents aged 26–45 years rated this question positively. Our finding showed that interest in eating insects (Question 2) depended on age. However, the numbers of assessors in these two age categories was not equal and therefore this finding can only be taken as a preliminary result.

The answers to the question asking whether respondents would cook insects at home were also in line with the above-mentioned literature. However, the suggested ways of culinary treatment were different in this work. The most commonly suggested treatments were baking, roasting and frying. Suggested ways of flavouring (garlic, caramel, chocolate or spices) could significantly modify the taste of insects. Results of the study of Megido et al. (2014) are slightly different. The preferred culinary treatments were insect salads or soups. However, these authors tested several species of edible insects, including larvae of mealworms, and they surveyed people interested in insects and the respondents' age range was wider.

Concerning neophobia and the age of people, Pliner & Salvy (2006) recorded a decrease of fear in older people. This agrees with the results of Megido et al. (2014), who served the respondents *Tenebrio molitor* and *Acheta domestica* cooked in different ways and found that they were more highly rated by a group of respondents over 45 years of age than by younger respondents. Pelchat (2000) stated that increased acceptability of new foods by older people may be associated with the decrease in their olfactory sensitivity. In contrast, Tuorila et al. (2001) speaks of a positive correlation between age and neophobia. In our results, there was no difference in acceptability with age. This could be due to the fact that the assessors were university students and staff with a relatively narrow age range of 19 to 45 years.

CONCLUSION

The results of the baked house cricket sensory analysis showed a statistically significant difference in the hedonic evaluation of overall pleasantness before and after tast-

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ing of the samples. The respondents rated the samples mostly negatively before tasting and this score improved by 52% after tasting. About one third of the total number of 98 assessors was not willing to taste house crickets. Women and younger assessors were slightly more open to entomophagy. There were no statistically significant differences between males and females or between the two age categories in the assessment. The preferred culinary preparation of edible insects that the respondents would choose was baking, roasting and frying.

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