Danish adolescents like their vegetables fresh rather than frozen or canned.

Federico JA Perez-Cueto[1*], Quenia Dos Santos[1], Belinda Nielsen[1], Caterina Dinnella[2], Erminio Monteleone[2], Agnès Giboreau[3], Laure Saulais[3], Laurence Depezay [4], Heather Hartwell[5], Katherine Appleton[5]

Keywords

VeggiEAT, adolescents, hedonic evaluation, vegetables, consumers

Affiliations

1. *University of Copenhagen, Food Design and Consumer Behaviour Section, Rolighedsvej 26, 1958 Frederiksberg C, Denmark*
2. *Università degli Studi di Firenze, Dipartimento di Gestione dei Sistemi Agrari, Alimentari e Forestali, Via Donizetti 6, 50144 Firenze, Italy*
3. *Centre de Recherche de l'Institut Paul Bocuse, Château du Vivier, BP 25 - 69131 Écully Cedex, France*
4. *Louis Bonduelle Foundation, Corporate Research & Communication, Food & Behaviours Department, Rue Nicolas Appert, 59650 Villeneuve-d'Ascq, France*
5. *Bournemouth University, Foodservice and Applied Nutrition Research Group & Health and Wellbeing, Faculty of Management, BH12 5BB, United Kingdom*

* Corresponding author

Abstract

Food choices in adolescence usually track into adulthood and are determinants of health outcome later in life. Efforts to promote vegetables consumption (as marker of healthy eating) have been implemented with limited success. Vegetables on top are perishable and their shelf life extended thanks to canning and freezing. The objective of this paper is to identify the influence that familiarity with and liking of vegetables may play in shaping attitudes towards canned and frozen vegetables among Danish adolescents. Ninety school age adolescents participated (57% girls, 15.7 y SD 1.17y). In this sample, majority of respondents were acquainted with vegetables (90%). Most liked vegetables were carrots, green salad, peas and corn. Lower liking levels were reported for squash, cauliflower and green beans. Most respondents showed a more positive attitude towards fresh vegetables rather than towards canned and frozen. Findings have implications for the provision of information through foodservice operations, and for the design of plant-based dishes and menus.

Introduction

Achieving sustainable and healthy eating is a major societal concern, and it is a day-to-day issue for consumers. Healthy eating can be at the same time sustainable since it is characterised by a balanced diet rich in foods of plant origin (vegetables, fruits, pulses), limited in foods of animal origin and avoiding highly processed foods (Perez-Cueto, 2015). Such diets have been associated to reduced risk of myocardial infarction, stroke, total mortality, heart failure, disability, cognitive decline and cancer (Martinez-Gonzalez & Martin-Calvo, 2016). A public health nutrition goal is to achieve 400g of fruits and vegetables per person daily intake at population level (WHO, 2008), while in Denmark the recommendation is higher (600 g or more/day) (Lynch et al., 2014).

The intake of foods of plant origin, particularly vegetables in Europe, the US, and across the world however, remain below World Health Organization recommendations (Bouchenak & Lamri-Senhadji, 2013). Although countries have been providing nutrition recommendations for populations in order to promote healthy and sustainable diets, and despite consumers knowing well the recommendations, changes towards higher vegetable intake have been limited (Perez-Cueto et al., 2012). One potential reason for this fact might be associated to the sensory properties of vegetables (Morizet, Depezay, Masse, Combris, & Giboreau, 2011), hence efforts to improve the taste of meals for e.g. school attending children are advocated (Cohen et al., 2015). Food intake in adolescence is a significant predictor of intake in adulthood and is influenced by gender, socioeconomic status and locality of residence (Lake, Adamson, Craigie, Rugg-Gunn, & Mathers, 2009; Mikkilä, Räsänen, Raitakari, Pietinen, & Viikari, 2007; Perez-Cueto, Almanza, & Kolsteren, 2005).

Processing of foods apart from affecting the nutritional composition of vegetables, also provides effects that are desirable on taste and texture (Fabbri & Crosby, 2016; Lindley, 1998). Moreover, consumption of canned fruits and vegetables has been associated to improved dietary quality and desirable health outcomes, hence could contribute to achieving the unmet national intake goals (Freedman & Fulgoni, 2016). Since in previous work Danish adolescents were positive towards actions that would help them making healthier food-related choices (Nørnberg, Skov, Houlby, & Pérez-Cueto, 2016), it would be also sensible to further elucidate adolescent's preferences towards preserved foods (canned or frozen) to further evaluate their potential role in increasing vegetable consumption at foodservice level.

Thence, the objective of this study is to investigate Danish adolescent's familiarity and liking of vegetables and their attitudes towards the consumption of fresh, frozen and canned vegetables.

Methods

Data collection: An online survey was carried out in January 2017 among Danish adolescents who were recruited using a snowball sampling procedure. Snowball sampling is used when respondents are added from the social network of existing participants since they should meet eligibility criteria, in this case being adolescents in Denmark. The survey's aim was to identify current attitudes towards canned and frozen vegetables and the evaluation of vegetables by adolescents. Attitudes towards canned, frozen and fresh vegetables were assessed by asking the degree of agreement of disagreement with a given statement. The Likert type scale ranged from 1 = fully disagree to 7 fully agree. Liking was evaluated using a hedonic scale ranging from 1 = extremely dislike to 9 = Like it very extremely. Familiarity with vegetables was evaluated on a scale where the following statements were given as choice: I don't know it, I know it but have not tasted it, I have tasted it but don't eat it, I eat it from time to time, I eat it regularly.

Data analysis: Descriptive statistics for continuous variables are expressed in mean (SD), proportions with a 95CI. Cronbach's Alpha was used to evaluate the internal consistency and unidimensionality of liking and familiarity scales (McCrae, Kurtz, Yamagata, & Terracciano, 2011; Tavakol & Dennick, 2011). Normality of data was evaluated using the Kolmogorov-Smirnov test (Ghasemi & Zahediasl, 2012). Association between liking scores and familiarity was evaluated with Spearman correlation since both scores were not normally distributed (de Winter, Gosling, & Potter, 2016; Mukaka, 2012). Further, exploratory factor analysis (Principal components and Varimax rotation) was performed to identify latent constructs within the attitudinal questions towards fresh, canned and frozen vegetables. Each of the attitudinal statements were used as dependent variable in linear regressions in order to control for

gender, age and daily consumption of fruits and vegetables, and to test whether these variable did or did not have any effect on each of the scores. A p-value less than 0.05 was considered statistically significant in all tests.

Ethics: This study was approved by the Scientific Committee of the Capital Region Copenhagen and has the number H-16034595. Further, the directives concerning subject's protection and Informed consent (1995/46/EC, 2001/20/EC and 2005/28/EC) have been applied as well as those concerning Human rights in Biomedicine (98/79/EC). Hence, data has been stored anonymously and respondents cannot be traced or contacted again.

Results

In total 90 Danish adolescents participated in the survey, (51 girls, 39 boys; mean age 15.7 y (SD 1.17), who on average consume 2.83 portions of fruits and vegetables daily.

Table 1 shows the familiarity levels and the hedonic evaluation of the listed vegetables. The main picture is that about 10% of the respondents either don't know the products or have not tasted them ever. Also, it highlights that all listed vegetables were liked by this sample of consumers (mean scores ranging from 5.5 to 7.8). Table 2 shows Spearman rho's for significant correlations between familiarities scores reported for different vegetables. Table 3 shows Spearman rho's for significant correlations between liking scores attributed to different vegetables. Table 4 shows Spearman rho's for significant correlations between liking and familiarity scores by vegetable item. As expected, high correlations were observed between familiarity and liking of each individual item, but also it is interesting to observe that further correlations exist with other vegetables, suggesting that the combination of these variables could provide an aggregated message: familiarity with vegetables in general is associated positively with liking of vegetables. Furthermore, Cronbach's Alpha for familiarity was 0.814 while its value was 0.830 for liking scale.

Table 5 displays the mean score (SD) of each of the attitudinal statements after controlling for gender, age and daily intake of fruits and vegetables. Furthermore, exploratory factor analysis identified four main latent structures explaining 66% of the variance. The first factor reveals positive attitudes and preference towards fresh vegetables, which are perceived as healthier and of higher quality. A second factor is explained by being uncomfortable with consumption of canned and frozen vegetables. A third factor suggests that given the choice between frozen and canned products, the

former is preferred. Lastly, the fourth factor suggests a pragmatic approach to cooking vegetables, where foreknowledge and convenience are keys.

Discussion

Overall, respondents reported high levels of familiarity and liking of the listed vegetables. Familiarity is described as the level of experience with a given object, in the case of the present study, familiarity refers to the experience with vegetables. Henceforth, majority of respondents were familiar with the 11 listed vegetables. Familiarity in this study is highly correlated with stated liking, confirming previous reports elsewhere for children, adolescents and adults (Dinnella et al., 2016). This is an important finding because large proportions of European adolescents do not fulfil fruits and vegetables recommendations, despite a high stated liking (Francou, Hebel, Braesco, & Drewnowski, 2015; Voracova, Sigmund, Sigmundova, & Kalman, 2015; Winkvist et al., 2016). Although the intake of fruits and vegetables have shown an increase among Danish adolescents compared to their counterparts in the other Nordic countries (Fismen et al., 2016), current consumption level is still not enough to reach the recommendations (Svastisalee, Holstein, & Due, 2012). Therefore, strategies to increase fruits and vegetables consumption among adolescents such as the development of new recipes with high acceptability must be reinforced taking into account their attitudes towards fresh, frozen and canned vegetables, but also considering their stated willingness to accept behavioural interventions that would facilitate easier sustainable and healthy choices (Nørnberg et al., 2016).

The attitudinal work suggests that adolescents in Denmark have specific beliefs related to consumption of fresh and canned vegetables. For them, fresh is the marker of quality and healthiness. And if they have to choose between frozen vegetables and canned ones, they would choose the former. The cue “fresh” therefore is key for future foodservice offers directed to the adolescent consumer. It is of the interest of the foodservice operators, but also of the industrial vegetables producers to further

communicate the advantages of preservation and preparation practices for vegetables (Fabbri & Crosby, 2016) and their role in achieving healthy and sustainable consumption (Freedman & Fulgoni, 2016).

This consumer study has limitations to be acknowledged. The first limitation is the data collection method used, which is convenience sampling using snowballing approach. The advantage of the method is that it is useful when the common characteristics of target group are relevant, and when information might be hard to reach (Heckathorn, 2011). Therefore, the findings of this paper need to be handled carefully in awareness of the potential bias incurred through the selection of respondents. The number of respondents is, however, adequate for achieving a power above of 0.8 on stated liking except for broccoli (0.70), green salad (0.1) and spinach (0.3). Power was calculated on the basis of (Dinnella et al., 2016) with http://powerandsamplesize.com. Therefore, the overall picture could be a fair representation of Danish adolescents sharing the similar characteristics of the sample.

Conclusion

This sample of Danish adolescents is familiar with vegetables, and state higher levels of liking thereof. Adolescents prefer fresh vegetables than those frozen or canned. Freshness is associated to the concepts of healthiness and higher quality. Therefore, efforts should be made to highlight the advantages of both frozen and canned products, and elucidate strategies so that they contribute to achieve dietary recommendations in the Denmark but also in EU.

Acknowledgements

This study was part of WP3 of VeggiEAT a Marie Curie IAPP/FP7 Project (No. 612326). We are thankful to the 90 Danish voluntary respondents.

References

Bouchenak, M., & Lamri-Senhadji, M. (2013). Nutritional quality of legumes, and their role in cardiometabolic risk prevention: a review. *J Med Food, 16*(3), 185-198. doi:10.1089/jmf.2011.0238

Cohen, J. F., Richardson, S. A., Cluggish, S. A., Parker, E., Catalano, P. J., & Rimm, E. B. (2015). Effects of choice architecture and chef-enhanced meals on the selection and consumption of healthier school foods: a randomized clinical trial. *JAMA Pediatr, 169*(5), 431-437. doi:10.1001/jamapediatrics.2014.3805

de Winter, J. C. F., Gosling, S. D., & Potter, J. (2016). Comparing the Pearson and Spearman correlation coefficients across distributions and sample sizes: A tutorial using simulations and empirical data. *Psychological Methods, 21*(3), 273-290. doi:10.1037/met0000079

Dinnella, C., Morizet, D., Masi, C., Cliceri, D., Depezay, L., Appleton, K. M., . . . Monteleone, E. (2016). Sensory determinants of stated liking for vegetable names and actual liking for canned vegetables: A cross-country study among European adolescents. *Appetite, 107*, 339-347. doi:10.1016/j.appet.2016.08.110

Fabbri, A. D. T., & Crosby, G. A. (2016). A review of the impact of preparation and cooking on the nutritional quality of vegetables and legumes. *International Journal of Gastronomy and Food Science, 3*, 2-11. doi:10.1016/j.ijgfs.2015.11.001

Fismen, A. S., Smith, O. R., Torsheim, T., Rasmussen, M., Pedersen Pagh, T., Augustine, L., . . . Samdal, O. (2016). Trends in Food Habits and Their Relation to Socioeconomic Status among Nordic Adolescents 2001/2002-2009/2010. *PLoS One, 11*(2), e0148541. doi:10.1371/journal.pone.0148541

Francou, A., Hebel, P., Braesco, V., & Drewnowski, A. (2015). Consumption Patterns of Fruit and Vegetable Juices and Dietary Nutrient Density among French Children and Adults. *Nutrients, 7*(8), 6073-6087. doi:10.3390/nu7085268

Freedman, M. R., & Fulgoni, V. L., 3rd. (2016). Canned Vegetable and Fruit Consumption Is Associated with Changes in Nutrient Intake and Higher Diet Quality in Children and Adults: National Health and Nutrition Examination Survey 2001-2010. *J Acad Nutr Diet, 116*(6), 940-948. doi:10.1016/j.jand.2015.10.013

Ghasemi, A., & Zahediasl, S. (2012). Normality tests for statistical analysis: a guide for non-statisticians. *Int J Endocrinol Metab, 10*(2), 486-489. doi:10.5812/ijem.3505

Heckathorn, D. D. (2011). COMMENT: SNOWBALL VERSUS RESPONDENT-DRIVEN SAMPLING. *Sociological Methodology, 41*(1), 355-366. doi:10.1111/j.1467-9531.2011.01244.x

Lake, A. A., Adamson, A. J., Craigie, A. M., Rugg-Gunn, A. J., & Mathers, J. C. (2009). Tracking of dietary intake and factors associated with dietary change from early adolescence to adulthood: the ASH30 study. *Obes Facts, 2*(3), 157-165. doi:10.1159/000219819

Lindley, M. (1998). The impact of food processing on antioxidants in vegetable oils, fruits and vegetables. *Trends in Food Science & Technology, 9*, 336-340.

Lynch, C., Kristjansdottir, A. G., Te Velde, S. J., Lien, N., Roos, E., Thorsdottir, I., . . . Yngve, A. (2014). Fruit and vegetable consumption in a sample of 11-year-old children in ten European countries--the PRO GREENS cross-sectional survey. *Public Health Nutr, 17*(11), 2436-2444. doi:10.1017/S1368980014001347

Martinez-Gonzalez, M. A., & Martin-Calvo, N. (2016). Mediterranean diet and life expectancy; beyond olive oil, fruits, and vegetables. *Curr Opin Clin Nutr Metab Care, 19*(6), 401-407. doi:10.1097/MCO.0000000000000316

McCrae, R. R., Kurtz, J. E., Yamagata, S., & Terracciano, A. (2011). Internal consistency, retest reliability, and their implications for personality scale validity. *Pers Soc Psychol Rev, 15*(1), 28-50. doi:10.1177/1088868310366253

Mikkilä, V., Räsänen, L., Raitakari, O. T., Pietinen, P., & Viikari, J. (2007). Consistent dietary patterns identified from childhood to adulthood: The Cardiovascular Risk in Young Finns Study. *British Journal of Nutrition, 93*(06), 923. doi:10.1079/bjn20051418

Morizet, D., Depezay, L., Masse, P., Combris, P., & Giboreau, A. (2011). Perceptual and lexical knowledge of vegetables in preadolescent children. *Appetite, 57*(1), 142-147. doi:10.1016/j.appet.2011.04.006

Mukaka, M. M. (2012). Statistics Corner: A guide to appropriate use of Correlation coe cient in medical research. *Malawi Medical Journal, 24*(3), 69-71.

Nørnberg, T. R., Skov, L. R., Houlby, L., & Pérez-Cueto, F. J. A. (2016). Attitudes and Acceptability of Behavior Change Techniques to Promote Healthy Food Choices Among Danish Adolescents. *Family and Consumer Sciences Research Journal, 44*(3), 264-279. doi:10.1111/fcsr.12142

Perez-Cueto, F. (2015). Sustainable and healthy diet?. Retrospective and implications for public health nutrition. *Revista Chilena de Nutricion, 42*(3), 301-305.

Perez-Cueto, F., Almanza, M., & Kolsteren, P. (2005). Female gender and wealth are associated to overweight among adolescents in La Paz, Bolivia. *European Journal of Clinical Nutrition, 59*(1), 82-87. doi:10.1038/sj.ejcn.1602040

Perez-Cueto, F., Aschemann-Witzel, J., Shankar, B., Brambila-Macias, J., Bech-Larsen, T., Mazzocchi, M., . . . Verbeke, W. (2012). Assessment of evaluations made to healthy eating policies in Europe: a review within the EATWELL Project. *Public Health Nutrition, 15*(8), 1489-1496. doi:10.1017/S1368980011003107

Svastisalee, C. M., Holstein, B. E., & Due, P. (2012). Fruit and vegetable intake in adolescents: association with socioeconomic status and exposure to supermarkets and fast food outlets. *J Nutr Metab, 2012*, 185484. doi:10.1155/2012/185484

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *Int J Med Educ, 2*, 53-55. doi:10.5116/ijme.4dfb.8dfd

Voracova, J., Sigmund, E., Sigmundova, D., & Kalman, M. (2015). Changes in Eating Behaviours among Czech Children and Adolescents from 2002 to 2014 (HBSC Study). *Int J Environ Res Public Health, 12*(12), 15888-15899. doi:10.3390/ijerph121215028

WHO, R. O. f. E. (2008). *WHO European Action Plan for Food and Nutrition 2007-2012* (E91153). Retrieved from Copenhagen, Denmark: http://www.euro.who.int/__data/assets/pdf_file/0017/74402/E91153.pdf

Winkvist, A., Hulten, B., Kim, J. L., Johansson, I., Toren, K., Brisman, J., & Berteus Forslund, H. (2016). Dietary intake, leisure time activities and obesity among adolescents in Western Sweden: a cross-sectional study. *Nutr J, 15*, 41. doi:10.1186/s12937-016-0160-2

Table 1 Familiarity and liking scores

	I don't know it (%)	I know it, but I have not tasted it (%)	I have tasted it, but I don't eat it (%)	I eat it from time to time (%)	I eat it regularly (%)	Mean liking score	SD
Broccoli	0	0	16	56	29	6,6	2,0
Carrots	0	0	4	29	67	7,8	1,4
Cawliflower	0	6	33	50	11	5,5	2,1
Green beans	1	6	27	44	22	5,9	2,2
Green salad	0	0	3	33	63	7,4	1,6
Peas	0	0	12	47	41	7,1	1,9
Spinach	1	7	17	49	27	6,2	2,2
Mais/corn	0	0	14	53	32	7,2	2,1
Tomatoes	0	1	17	21	61	6,9	2,5
Squash	1	9	36	44	10	5,5	2,2
Other beans and vegetables	1	10	26	48	16	5,6	2,3

Table 2: Spearman rho's for significant correlations between familiarity scores reported for different vegetables

Familiarity	Broccoli	Carrots	Cawliflower	Green beans	Green salad	Peas	Spinach	Mais-corn	Tomatoes	Squash	Other beans & vegetables
Broccoli	1	.387**	.533**	.464**	n.s.	.290**	.478**	.222*	n.s.	n.s.	.255*
Carrots		1	.254*	.291**	.275**	.378**	.452**	.321**	n.s.	n.s.	.279**
Cawliflower			1	.477**	n.s.	.250*	.583**	.234*	.250*	.439**	.421**
Green beans				1	n.s.	.219*	.573**	n.s.	n.s.	.305**	.556**
Green salad					1	.213*	.213*	n.s.	.237*	n.s.	n.s.
Peas						1	.244*	.472**	n.s.	n.s.	n.s.
Spinach							1	.277**	.289**	.299**	.432**
Mais-corn								1	n.s.	n.s.	n.s.
Tomatoes									1	.304**	n.s.
Squash										1	.506**
Other beans and vegetables											1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table 3: Spearman rho's for significant correlations between liking scores attributed to different vegetables

Liking scores	Broccoli	Carrots	Cawliflower	Green beans	Green salad	Peas	Spinach	Mais-corn	Tomatoes	Squash	Other beans & vegetables
Broccoli	1	.397**	.575**	.414**	.209*	.284**	.366**	.307**	n.s.	.239*	.335**
Carrots		1	n.s.	.346**	.434**	.345**	.233*	.307**	n.s.	n.s.	.369**
Cawliflower			1	.464**	n.s.	.280**	.474**	.297**	n.s.	.354**	.520**
Green beans				1	.232*	.324**	.526**	.284**	n.s.	.412**	.723**
Green salad					1	.343**	.284**	n.s.	.271**	.244*	.243*
Peas						1	.292**	.385**	.237*	.263*	.341**
Spinach							1	n.s.	.378**	.409**	.554**
Mais-corn								1	n.s.	n.s.	.231*
Tomatoes									1	.327**	.228*
Squash										1	.454**
Other beans and vegetables											1

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

n.s. = not significant

Table 4: Spearman rho's for significant correlations between liking and familiarity scores by vegetable item

Familiarity \ Liking	Broccoli	Carrots	Cawliflower	Green beans	Green salad	Peas	Spinach	Mais corn	Tomatoes	Squash	Other beans & vegetables
Broccoli	.566**	.262*	.470**	.408**	n.s.	n.s.	.351**	.258*	n.s.	n.s.	.238*
Carrots	.346**	.648**	.139	.383**	n.s.	.437**	.268*	.358**	n.s.	n.s.	.352**
Cawliflower	.370**	.079	.673**	.446**	n.s.	.218*	.466**	.218*	.237*	.367**	.464**
Green beans	.234*	.134	.344**	.758**	n.s.	n.s.	.457**	n.s.	n.s.	n.s.	.576**
Green salad	n.s	.213*	n.s.	n.s.	.521**	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
Peas	.298**	n.s.	.271**	n.s.	n.s.	.498**	n.s.	.311**	n.s.	n.s.	n.s.
Spinach	.313**	.313**	.477**	.496**	n.s.	.244*	.711**	.244*	.296**	.265*	.461**
Mais-corn	.313**	n.s.	n.s.	n.s.	n.s.	.275**	n.s.	.552**	n.s.	n.s.	n.s.
Tomatoes	n.s	n.s.	n.s.	n.s.	n.s.	n.s.	.292**	n.s.	.776**	.218*	n.s.
Squash	n.s	n.s.	.311**	.375**	.218*	.239*	.354**	n.s.	.312**	.789**	.433**
Other beans and vegetables	n.s	.225*	.405**	.547**	n.s.	.304**	.411**	n.s.	.227*	.379**	.775**

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table 5

Attitudinal statements	Mean	SD
I prefer vegetables from the freezer rather than fresh vegetables	2,06	1,19
I think that vegetables canned are just as delicious as fresh vegetables	2,34	1,37
I think that fresh vegetables are healthier than vegetables from frost	5,34	1,56
I am uncomfortable eating vegetables canned	3,47	1,77
I think it is easier to cook with vegetables from frozen or canned rather than fresh vegetables	3,14	1,60
When it comes to vegetables, I am a creature of habit. I prefer vegetables that I'm used to eating	4,38	1,62
I prefer peas from the freezer rather than canned peas	4,71	1,62
I think that fresh vegetables are healthier than vegetables canned	5,56	1,51
I am uncomfortable eating vegetables from frost	2,73	1,47
I think that fresh vegetables are of higher quality than vegetables from frost	5,94	1,23
I prefer corn from the freezer rather than corn canned	3,38	1,56
I think that fresh vegetables are of higher quality than vegetables canned	6,08	1,29