# Factors Affecting the Consumption of Soy-based Foodstuffs in Hungary

Viktória Szűcs

Directory of Food Industry, Hungarian Chamber of Agriculture, Budapest, Hungary Email: szucs.viktoria@nak.hu

Erzs chet Szabó

Department of Technology and Food Chain Analysis, National Agricultural Research and Innovation Centre - Food Science Research Institute, Budapest, Hungary

Email: szabo.erzsebet@eki.naik.hu

Abstract-According to the most optimistic forecasts, alternative sources have to be found to cover the protein needs of expanding population. Soy is a potential ingredient for substitute of meat. However, it is an 'unconventional' ingredient in Hungary and mainly consumed in Asian restaurants. Therefore, identification of the consumption frequency and exploration of the factors influencing the present and future (intention) consumption of sov-based foodstuffs are reasonable. For this purpose a quantitative survey was conducted with Hungarian participants (N= 411) having mixed diet. Theoretical models of the present and future soy-based foodstuff consumption were developed and validated by the results of the survey (path analysis). Consumption frequency of soy sauce was found to be notable, while the popularity of other soy products was much lower. Results of the model validation pointed out that health-related factors and sov-related attitude seem to be key element in actual soy product consumption, while future actions are mainly influenced by more detailed knowledge of health benefits and the dominance of sustainable thinking in Hungary. Findings of our study might be useful for product development and communication activities as well.

*Index Terms*—soy consumption, intention, attitude, healthy lifestyle, suspicion, sustainable consumption

## I. INTRODUCTION

As the global population set to continue expanding at an alarmingly rapid rate, the demand for meat and meat substitutes becoming an outstanding problem. There are several plants suitable for the production of meat substitute products including wheat, peas, lupin and soy. Nevertheless, the rising occurrence of allergic reactions to the one or other substance set measures to the widespread application of these ingredients. Soy is recognized as a potent food allergen producing one of the most frequent food allergies. However, nonthermal food processing technologies (like pulsed ultraviolet, direct and remote cold atmospheric pressure plasma and gamma-irradiation) can have positive effect on the residual immunoreactivity of soy [1]. As soy protein is used to increase the protein percentage and water retention of meat products, meat products with soy are often referred to as 'poor quality' ones. Potential presence of soy has to be listed among the ingredients of a given foodstuff and has to be declared as allergen component (1169/2011/EU) [2]. Although putting 'soy' on food packages negatively influences taste-conscious consumers' shopping decisions; combining with a health claim fosters positive attitude of health-conscious buyers, natural food lovers, or dieters [3].

Despite soy based foodstuffs are basic elements of different Asian cuisines, vegetarians are the main consumers of them in the rest of the world. However, due to the international spreading of oriental cuisines - like Chinese and Japanese - soy based ingredients appeared in the European diet as well [4]. Surveys related to soy consumption are limited in Europe. Overall perception of soy foods and soy protein for example was found to be positive among Italian consumers. The most frequently consumed soy products were nutrition bars, snacks and beverages. The main benefits of soy consumers cited were no cholesterol, hearth health, weight management and no lactose [5]. Consumers in the United States had less nutritional knowledge about soy foods [6], but the consumption was found to be higher than ever in 2016. The most frequently consumed ones were soymilk, energy bars, edamame, tofu, soy veggie burgers and miso [7].

The aim of the present study was to determine and model the factors that influence the frequency of soy product consumption in Hungary.

## A. Development of the Thoratical Model

In order to analyse the direction and strength of effects influencing the actual and intentional consumption of soy-based products, two theoretical models were developed on the basis of literature review (Fig. 1, 2).

Everyday thinking of new foods varies from suspicion to trust, from longing for naturalness to trusting in technology, and from regarding food as an enjoyment to regarding food as a necessity. Baäckstroäm and co-

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authors [8] found that suspicion had negative correlation with change-seeking tendency, suggesting a restrained view on new food ( $\beta$ 1). However, positive attitudes can redound greater consumption [9]-[11], so positive personal attitude toward soy can have positive effect on the consumption frequency ( $\beta$ 2) [12].



Figure 1. The theoretical model of soy product consumption.

Sustainability and health refer to quality dimensions that cannot be experienced by consumers, so these characteristics can have influence on consumers' product choices ( $\beta$ 3,  $\beta$ 4,  $\beta$ 5) [13]. Furthermore, study of Vanhonacker and co-authors [14] emphasizes that in order to maintain a sustainable environment, meat alternatives should be attractive not only for vegetarian consumers but also to current meat consumers ( $\beta$ 3).

Saba and Vassallo [10] found that beliefs provided a high contribution to the prediction of attitudes ( $\beta$ 10). Research study of Balasubramanian and co-authors [12] showed that health benefits of soy has a positive influence on soy-related beliefs ( $\beta$ 13), which has favorable outcomes on the personal attitudes toward soy ( $\beta$ 10). Furthermore, personal attitudes are directly influenced by the health benefits as well ( $\beta$ 11). Health is a motivating factor for both healthy eating and physical activity ( $\beta$ 12) [15].

Neophobic (people who present rejection towards new or unfamiliar foods) consumers tend to exhibit negative attitudes ( $\beta$ 6) and have lower expectations regarding the trying of foods ( $\beta$ 1) [16].

Pelletier and co-authors [17] found relationship between the preference of sustainable foods and the dietary quality ( $\beta$ 8). Additionally, sustainable foods appear to have attitudes and motivations related to their purchasing decisions ( $\beta$ 7) (Fig. 1).



Figure 2. The theoretical model of intention to consume soy product.

Based on the theory – emphasizing there is a difference between intention and real action – of Fishbein and Ajzen [18] to analyze the intention to consume soybased products, another model was developed. The intention model contains the same background connections as the consumption model (Fig. 2).

## II. MATERIALS AND METHODS

## A. Participants

The sample consisted of 411 Hungarian participants having mixed diet of whom 294 (71.5%) were female. 58.6% of the respondents was between the age of 18 and 34, 36.5% between 35 and 59, and only 4.9% over 60 years. Almost half (49.4%) of the respondents were inhabitants of the capital (Budapest), 65.2% were higher educated and 64% lived among average income conditions.

#### B. Measures

Respondents were administered a questionnaire containing the statements from Table I. Variable of 'soy product consumption' (dependent variable of soy product consumption model) referred to the consumption frequency of several soy-based products. Some statements of 'soy-related personal beliefs' (1-4) and 'health benefits of soy' (1-6) was originated from the study of Blasubramanian and co-authors [12]. Factors of 'intention to consume soy product (dependent variable of intention to consume soy product model), 'sustainable consumption' and 'soy-related attitude' were developed by the authors. The suspicion dimension contained items related to the unnecessary and artificial nature of new foods [8]. In order to describe the individuals' way of living related to health items of the 'Healthy Lifestyle Scale' developed by Gil et al. [19] was utilized.

TABLE I. MODEL CONSTRUCTS AND RELIABILITY INFORMATION (COMPONENT LOADINGS> 0.25; BARTLETT'S TEST= 0.000)

1. Soy product consumption (Cronbach's alpha=0.870; KMO= 0.874)*
Soy milk/drink
Tofu
Soy sauce
Soy germ
Soy yogurt
Tempeh
Soy p ât é
Soy flour/flake
Textured soy product
Soy cream
Soy oil
Roasted soy seed
2. Intention to consume soy product (z-score)**
I am planning to try soy products and recipes containing soy.
I am planning to increase my soy product consumption.
3. Soy-related personal beliefs (Cronbach's alpha= 0.780; KMO=
0.782)**
Soy-based foods pose health risks to me.
Soy-based foods are not good for me.
Soy-based foods are unnatural.
Food products made from genetically engineered soy beans present
health risks.
Only Asian people get accustomed to the consumption of soy.
Soy is valuable food; it is time to discover it by the European
nutritional culture

If too much soy is utilized in a foodstuff (e.g. cold cuts), it will
negatively affect its quality.
4. Health benefits of soy (Cronbach's alpha= 0.849; KMO= 0.832)**
Soy may lower cholesterol level in your blood.
Soy acts as an antioxidant.
Soy may help retain bone mass, thereby reducing the risk of
osteoporosis.
Soy may be good for menopause or other female diseases.
Soy may replace milk products.
Soy may replace meat products.
Soy is nearly complete protein source.
Soybean is purer product than the meat or milk, because free of
hormones, drugs used in animal husbandry.
Soybean is fiber content is outstanding.
Soy may lower the risk of cardiovascular diseases.
5. Sustainable consumption (Cronbach's alpha= 0.836; KMO= 0.699)*
Because of environmental sustainability, moderation of the animal
protein is the future of the welfare states.
Welfare states have to push the consumption of more plant and less
animal origin foodstuffs.
Plant protein sources are key elements of the human nutrition.
6. Soy-related attitude (Cronbach's alpha= 0.526; KMO= 0.569)**
Soy products are expensive.
Soy products do not fit into the Hungarian taste.
Flavour and nutritional effect of meat cannot be replaced by plant
protein products.
7. Resistance to and suspicion of novelties (Cronbach's alpha= 0.667,
<i>KMO</i> = 0.735)**
There are too many new foods available nowadays.
New foods are useless vanity.
I prefer familiar and safe foods.
There are some doubts about novelties.
Traditionally made food is the best in the world.
Functional food is like a nuclear power plant: forceful but
dangerous.
Contemporary food is artificial compared with the food available in
my childhood.
Health enthusiasm causes unnecessary stress.
8. Healthy lifestyle (Cronbach's alpha= 0.760; KMO= 0.783)**
I do exercise regularly.
I avoid eating processed food.
I often eat fruits and vegetables.
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.

\* 1= never; 5= regularly; \*\* 1= do not agree; 5: totally agree

## C. Data Analysis

Consumption frequency of the selected soy products were evaluated by frequency data.

Regarding the model validation as a first step – in order to create the variables of the model – a factor analysis was done; however, the 'goodness-of-fit test' did not show significant fitting and the resulted factors were not applicable. So as a next step principal component analysis (PCA) was done. Created components that did not load with a value higher than 0.25 were removed, and the PCA was re-run.

Adequacy of the variables in the sample was measured with KMO (Kaiser-Meyer-Olkin) and Bartlett's Test of Sphericity. KMO ranges from 0 to 1 and accepted index is greater than 0.5. Bartlett's Test refers to the relationship between the variables, thus must be less than 0.05 [20]. Reliability of the variables was measured by Cronbach alpha. According to the literature summary the accepted values of alpha ranging from 0.50-0.95 [21]-[23]. In case of variable containing only two elements (intention to consume soy product) a standardized ariable (z-score) was created in order to accommodate spondents' answers (1-5 Likert scale) to the range of e principal components. Finally, by means of the reated principal components (variables) a path analysis PA) was done which is a causality model for the nderstanding of the connections between the variables 24], [25]. In fact, this method is the series of regression odels, where variables are linked with arrows showing e direction. The intermediate variables can have a direct nd an indirect (through other variables) effect on the ependent variable. The ways'  $\beta$  values (standardised artial regression coefficients or path coefficients) show e strength of the connection between the two variables, nd its' sign the direction of the relation. For the data nalysis IBM SPSS Statistics 24.0 (IBM, Armonk, New ork, USA) was used.

### III. RESULTS AND DISCUSSION

### . Consumption Frequency of Soy Products

Analysis of the consumption frequency of the listed twelve soy products showed that more than half (52.1%) of the Hungarian participants consumed soy sauce regularly (12.9%) or occasionally (39.2%). Lower frequency was found in case of tofu (21.4%), soy germ (16.1%), soy milk and drinks (13.6%), textured soy products (13.4%) and roasted soy products (10%); while less than 10% of the respondents was identified as regular or occasional consumer of products like pât é, flour and flake, oil, cream, yogurt and tempeh. However, it is important to highlight that soy sauce was the most regularly consumed product (12.9%), followed by pât é (4.9%), milk or drinks (3.9%) and textured products (3.2%) (Fig. 3).

Beside the low consumption frequency, the highest willingness to try was found in case of tempeh (16.5%), roasted soy seed (15.1) and soy yogurt (14.4%).



Figure 3. Consumption frequency of different soy products.

#### B. Validation of the Theoretical Model

Continuous lines show the significant (p< 0.05) ways, while dashed lines represent the non-significant ways in the validated models (Fig. 4, 5).

The explanatory power of the first model regarding the factors affecting the 'soy product consumption' was 23.6% (Durbin-Watson= 1.821; F= 43.171) (Fig. 4). According to the model it can be stated that 'soy-related attitude' (-0.344), 'healthy lifestyle' (0.217) and 'health

benefits of soy' (0.146) had a direct impact on the 'soy product consumption'. 'Soy-related attitude' had the strongest influence on the dependent variable, which was significantly influenced by several factors like the 'sustainable consumption' (-0.291), 'resistance to and suspicion of novelties' (0.244) and 'health benefits of sov' (-0.156). Despite 'resistance to and suspicion novelties' direct effect was not significant to the 'consumption', positive 'soy-related personal beliefs' can influence it (0.281) which can thus form the 'attitude' (0.244) resulting in increased 'soy product consumption' (-0.344). 'Sustainable consumption' did not have significant influence on the 'consumption' directly; however, through the 'soy-related attitude' (-0.291) had indirect effect on it. 'Health benefits of soy' was positive contributor to the forming of 'soy related attitude' (-0.156). 'Soy-related personal beliefs' as a starting-point can influence the 'soy product consumption' through other variables ('resistance to and suspicion of novelties' and 'soy-related attitude').



Figure 4. The final model of soy product consumption.



Figure 5. The final model of intention to consume soy product.

The explanatory power of the model regarding the factors affecting the 'intention to consume soy product' was 31.5% (Durbin-Watson= 2,052; F= 38.773) (Fig. 5). Thus, variables of the model describe the 'intention' more precisely than the 'consumption'. Differences of the significant ways between the two models are outstanding. While in case of the first model 'soy-related attitude' (-0.344) and 'healthy lifestyle' (0.217) had the strongest effect on the 'consumption', 'intention' was most significantly influenced by the 'health benefits of soy'

(0.366) and the 'sustainable consumption' (0.206). This result highlighted the importance of trainings from the point of view of healthy and sustainable food consumption. Furthermore, it can be stated that progress on the field of health - and environmental awareness can have significant boost on the consumption of soy-based foodstuffs.

Both models agreed – in contrast with the previous expectance – that 'resistance to and suspicion of novelties' did not has significant effect on the dependent variables. Consumption of soy-based products is not influenced by the acceptance of novelties. Thus, Hungarian consumers do not regard these products as novelties that have to be resisted. High Cronbach's alpha values and significant connections between the 'soyrelated personal beliefs' and the 'health benefits of soy' (-0.268), as well as between the 'resistance to and suspicion of novelties' and the 'soy-related attitude' (0.244) show that these topics interact with each other. In other words, broadening consumers' knowledge might have health benefits for them.

Direct effect of the 'healthy lifestyle' was identified in case of actual 'soy product consumption' (0.217). Thus it can be stated that those consumers who do not follow healthy lifestyle currently, but having favorable judgement about the health effects of soy are planning to increase their soy-based product consumption in the future.

Noteworthy, that 'soy-related attitude' had less direct impact on the planned consumption (-0.161) than on the present consumption (-0.344); respondents willing to consume higher amount of soy-based products having varied opinions about soy. Thus, enhancement of present - and future consumption of soy-based products can be explained by novelty seeking.

## IV. CONCLUSIONS

Although soy does not belong to the basic ingredients of the Hungarian cuisine, its' potential importance is indisputable from the perspective of sustainability.

Results of the present study showed, that – partly due to the spreading of international cuisines such as Chinese and Japanese in Hungary – consumption frequency of soy sauce was found to be notable, while the popularity of other soy products was much lower.

In this study present and planned soy-based foodstuff consumption tendencies' influencing factors were analysed. It can be stated that health-related factors and forming of the soy-related attitude can be key elements in soy product consumption, while intention is strongly influenced by the knowledge of the health benefits of soy and the dominance of sustainable thinking in Hungary. Comparison of the validated models outlines the future soy consumption tendencies and target groups. According to this, trying and consumption of soy-based products are typical of those who judge their health impacts favorably, search for novelties and committed to sustainability.

Several findings of the validated models were in line with the literature [5], [12], [16], [17], while regarding

others significant connections were not confirmed [5], [8], [10], [14]-[16].

If the rate of soy-based products is aimed to increase in Hungarian diet, health - and marketing communication utilization of the present findings is recommended during product development.

The present study traces out some research topics like the identification of the effects outside of the model and analyses the strength of the model factors in the case of sensitive consumer groups (e.g. young mothers).

The opinions expressed herein and the conclusions of this publication are those of the authors and do not necessarily represent the views of the Hungarian Chamber of Agriculture.

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Viktória Szűcs was born in Miskolc, Hungary, 1982. She received her MSc degree in Food Engineering in 2007 and her Ph.D degree in Agrotechnical in 2014 from the Corvinus University of Budapest. As the research fellow of National Agricultural and Innovation Centre - Food Science Research Institute she conducted several qualitative and quantitative consumer studies and – as the head of the sensorial laboratory – sensory

analysis. She participated in several national, EU FP7 projects (FACET, SPICED) and international co-operations (EATMOT). In 2011 as a scholarship holder she spent four months in IRTA (Research & technology Food & Agriculture), Monells, Spain. Her primary research activities are consumer behavior, food safety and healthy nutrition related issues. She has more than 70 research publications. Currently she is the food industry expert of the Hungarian Chamber of Agriculture, Hungary.



**Erzs dbet** Szabó was born in Budapest, Hungary, 1954. Her qualifications are food engineer (1977 – University of Horticulture and Food, Budapest) and economic engineer (1992 – Budapest University of Technology). She defended her Ph.D dissertation in management and organization sciences on the Corvinus University of Budapest in 2006. She took part so far in many national and EU research projects (NovelQ, Hightech Europe,

FACET, SPICED). Her main research areas are the consumer behavior, food labelling, consumer acceptance of novel technologies and the food quality systems. She has more than 110 research publications. Currently she is a senior scientist at the National Agricultural Research and Innovation Centre - Food Science Research Institute.