Business Model of Consumer Behavior with Included Nutritional Determinant

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Abstract: *The success of the operations of the companies that work with food products depends a lot on having information about the consumer purchasing decisions, and based on that, inclusion of marketing strategies that will ensure their success. Business models of consumer behavior can answer these important questions. The inclusion of nutritional determinants in these models is significant, and the model will provide answers to the extent of its impact on consumer behavior. Scope of the study within this paper is an applied original modeling concept for creating business models of consumer behavior when buying food products, where special emphasis is given to the nutritional properties of food products, i.e. in addition to other known determinants, the model includes a new determinant called nutritional. The model is built on several principles using modern information technologies, and one of the important principles is to provide greater clarity for a full understanding of the process involved in the model with integrated self-explanatory functionality. The model was partially implemented with data obtained from several surveys conducted in our research, and as outputs of the model, a set of customer responses were obtained.*

1. INTRODUCTION

Most companies research consumer shopping decisions in detail, in order to answer the following questions: what do consumers buy, where do they buy, how much do they buy, when do they buy and why do they buy. But the answers to these questions are not easy to obtain, because the answers are often hidden deep in the mind of the consumer. The process of decoding consumer behavior when shopping is a complex task because a number of factors (external and internal) of influence need to be determined (Solomon, 2006). However, human shopping behavior, despite its diversity, can be modeled on a consumer behavior model (Kotler & Amstrong, 2008), and by including the necessary economic methods, it can be presented as a business model. As a result, consumer behavior can be explored by analyzing all dynamic behaviors in a series of assumptions and conditions.

In the business models on consumer behavior it is necessary to include scientific methods and concepts using modern information technology such as database management system (DBMS), for consumer database management with information obtained from various sources; geographic information system (GIS), (Pick, 2005, Martinovski, 2017, Martinovski, 2013) which will create thematic consumer maps and business areas, models that can describe the current situation and design future strategies; advanced analysis of databases using data mining methods, such as Association Rules and the Apriori Algorithm, classification and cluster analysis, (Perner, 2006, Jannach et al., 2011, Han et al., 2012), methods that will enable obtaining a large amount of information and knowledge about purchasing rules and clustered customer profiles. The pan-

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demic caused by the coronavirus has changed the way consumers react to food, their behavior when choosing food and how they perceive their diet in general. Similarly, during the pandemic, a number of questions were raised about disease prevention which is one of the important topics in medicine and nutrition through the consumption of high quality nutritional food, and is a significant factor influencing the purchase of food products. Our other research shows an upward trend of food consumers who pay attention to their diet and think about the nutritional quality of food products (Martinovski & Spirovska-Vaskoska, 2015, Martinovski, 2016).

2. NUTRITION DETERMINANT

Nutritionism is a multidisciplinary, scientific and applied field based on food science and nutrition. The study of the composition of food, the nature of nutrients and their impact on the human body (Smolin & Grosvenor, 2011, Taylor, 2007) is one of the main goals of nutritionism. Improving health through a healthy diet, the importance of people's nutritional needs and general diet are increasingly important to consumers. Therefore, the inclusion of nutritional determinants in business models of consumer behavior is important and necessary, and consumers are increasingly sensitive to the declarations of food products with marked nutritional properties (Martinovski & Simovska-Jarevska, 2015). These models will provide answers (outputs) to a number of questions that are important for a successful marketing strategy of companies in the food industry, especially the degree of impact of the determinant - nutritional properties. Thus, companies can direct the development in expanding the profile of their products, by improving the nutritional quality and increasing the profit.

The elements of the nutrition determinant, that are important for consumer behavior, are shown in Table 1. This entity consists of three attributes: 'Nutritive element', 'Content and quantity', and 'Significance rating' for a specific product group (from 1-lowest to 5-highest). In the development of food products, it is analyzed which of the nutritional properties of the nutritional determinant are important for food products. Most companies focus only on certain segments of the overall market, choosing the best segments for them with design strategies for profit. Companies need to target segments in which they can generate the most purchasing value. Differentiation and positioning of food products on the food map is increasingly directed according to the content of nutrients (Table 1). Food products with increased nutritional quality determined through content and quantity (rank of significance), will receive added value and thus greater purchase value and increased impact on purchasing.

Table 1. Nutrition determinant

Nutrition element	Content and quantity	Importance rank for a certain group of products (from 1 to 5) *
Carbohydrates and energy value	Content and quantity in the form of: monosaccharides (glucose, fructose, sucrose), disaccharides, oligosaccharides, etc.	
Proteins	Quantity and origin: vegetable or animal	
Vitamins and minerals	Content and quantity	
Organic acids	Content and quantity of: ormic, oxalic, citric, tartaric, lactic, malic, pyroglutamin, glucose, valerian, benzoic and other higher fatty acids	
Salts	Content and quantity of: phosphates, chlorides, sulfates	

Micro and macro elements	Content and quantity of: tin, sodium, calcium, phosphorus, sulphur, chlorine, magnesium, iron, aluminum, mercury, manganese, chromium, zinc, lead, arsenic, cadmium, titanium	
Aminoacids	Content and quantity of: lysine, histidine, arginine, aspartic acid, threonine, serine, glutamic acid, proline, glycine, cystine, valine, methionine, isoleucine, leucine, tyrosine, phenylalanine, tryptophan	
Enzymes	Content and quantity of: invertase, diastase (amylase), catalase, acid phosphatase, glucose-octase, polyphenoloxidase, peroxidase, esterase and proteolytic enzymes	
Lipids	Content and quantity of: triglycerides, sterols, phospholipids, free fatty acids, fatty acid esters	
Fibers	Content and quantity	
Nutritional health claims	Certificates	
Sensory characteristics	Color, taste, smell, hardness	
Product safety	Security standards	
Certification	Organic food, for quality	

* The importance of the nutritional property contained in the food product is determined, as follows: 1 - It does not matter, 2 - A little significant, 3 - Moderately significant, 4 - Significant, 5 - Very important

Source: Authors

3. BUSINESS MODEL OF CONSUMER BEHAVIOR

In the development of known models of consumer behavior, several types are encountered: models for identical consumers or different consumers; continuous valued or discrete valued models; lumped model or agent model; deterministic or probabilistic, linear ODE model; models for continuous product range or finite number of brands, etc. They include cultural, personal, psychological and sociological determinants, but none include the nutritional determinant when it comes to food products. Regarding the use of these models, little has been done in terms of understanding and it has been reduced to help. We think that is not enough, and because of that, there may be difficulties in their use by end users.

The concept of modeling for creating a business model of consumer behavior with the included nutritional determinant that we propose differs from the previously listed concepts of models, in that the proposed model includes all methodologies (which include all methods used in the model), inputs and outputs are represented as relational entities (E/R model), and each method consists of attributes. This structure of the model has a number of advantages, as follows: a) easy further development; b) easy application use; and c) self-explanation of the model.

The modeling stages we propose are represented as entities in a relational model (E-R model), including:
Stage 1: Output - Methodology – Input,
Stage 2: Conceptual model,
Stage 3: Logical model,
Stage 4: Physical model,
Stage 5: Verification of the model with feedback.

Stage 1 defines three main groups of entities: Output-Methodology-Input. First, the Output entity defines all outputs of the model and their forms (analytical form, graphical representation, or thematic map). The paper theoretically explains the model for food products, and in the following text only a part of the entities involved in it are shown and a partial implementation is made with data from survey research. Typical outputs for business models with the nutritional determinant included are:

Ou_1= degree of influence of: nutritional properties (nutritional quality), price, packaging and sensory characteristics, in analytical and graphic form.

Ou_2= degree of impact on quality and safety, in analytical and graphic form.

Ou_3= degree of impact of the declarations on which the nutritional properties are written, in analytical and graphic form.

Ou_4= Determining independence between education and nutritional properties, in analytical form.

Ou_5= Determining independence between gender and nutritional properties, in analytical form.

Ou_6= Determining independence between age and nutritional properties, in analytical form.

Ou_7= Determining independence between several different nutritional properties, in analytical form.

Ou_8= Consumer clusters.

Ou_9= Thematic maps of consumers (profitable consumers) by areas.

All these outputs are defined in the entity Ou_m. Second, the methodology(s) and required input are defined for each output.

For Ou_1:
    Methodology 1 (M1.1, M1.2, M1.3, M1.4, M1.5) - average, standard deviation, variance, frequency, SUM and
    Methodology 2 (M2.1) - Rank based method

For Ou_2 and Ou_3:
    Methodology 1 (M1.1, M1.2, M1.3, M1.4, M1.5)

For Ou_4, Ou_5, Ou_6 and Ou_7:
    Methodology 3 (M3.1, M3.2) - Frequency, Chi-Square test and Cramer's V test

For Ou_8:
    Methodology 4 (M4.1) - Partitioning Clustering Method on a pattern of three answers to three different questions, pattern1: question1 - answer1, question1 - answer2 ... question3 - answer3

For Ou_9:
    Methodology 5 (M4.1) - GIS methods - mapping

Methods and their attributes required to obtain predefined outputs are:
    M1.1 (category, frequency, average)
    M1.2 (category, frequency, standard deviation)
    M1.3 (category, frequency, variance)
    M1.4 (category, frequency, frequency)
    M1.5 (category, frequency, SUM)

M2.1 (category, frequency, rank, ranking)
M3.1 (category, frequency, df, p, α, Chi-Square)
M3.2 (category, frequency, Chi-Square, Cramer's V)
M4.1 (category, frequency pattern1, consumer clusters)
M5.1 (category, frequency, Area, GIS mapping)

For all entities - methodology required inputs are: database created from survey research and consumer databases.

The methods set two statistical hypothesis tests: Chi-Square and Cramér's V to determine the independence between two nominal variables. Each variable must have two or more categories. Data are used that reflect the total number of cases (frequency of cases) placed as pairs. In the analysis of independence between two variables, one possibility is to perform a Chi-Square independence test. If the p-values are close to zero (or $α > p$, $α = 0.05$), the null hypothesis of independence is refuted, which means that the variables are very likely to be statistically significant. However, this does not mean that the two variables are strongly related; it can happen that there is a weak relationship between the variables and p is around zero. Therefore, the Cramér's V test is additionally used, which uses the obtained value of Chi-Square and determines how strong the relationship is between the two nominal variables. The value of Cramer's V is in the range of 0 to 1, and the closer the value is to 1 the stronger the dependence between the two variables.

Partitioning Clustering Method is a method of data mining for grouping by classifying (dividing) information into multiple groups based on the characteristics and similarity of the data. The clustering method is used when the database contains multiple objects, creating user-specified data partitions in which each partition is a cluster and a specific area. There are several algorithms for division, and the most commonly used are: K-Mean, PAM (K-Methods) and CLARA algorithm (Clustering Large Applications. Classification is a model for data analysis, i.e. the process of finding a model that describes and distinguishes classes and concepts of data.

Stage 2 - **In the conceptual model** of the nutritional business model, concepts of all entities and all possible relations are established. The model includes the nutritional determinant as an entity (Table 1 and Figure 1). This entity is related to all other entities. In this phase, the relations between the entities are established: Output (Ou_m) - Methodology (Methodology n) - Input (In_j) and relation between the entities from the methodologies (Methodology 1 - Methodology n). Each methodology consists of methods ($M_{n.i}$), and each method consists of attributes (At_k).

Stage 3 - **In the logical model (Figure 1)** all entities and defined relationships between entities in the E-R model are set so that obtaining a self-explanation of the process is ensured. This means that for each output there will be a specific explanation of how it is obtained, which methods, inputs and data sources are used. $SEOu_m = (M_{n.i} \& In_j)$. This structure of the model allows easy further development and easy application. Where:

$M_{n.i}$: i = th method of n-th methodology
Ou_m: m-th output, In_j j-th input
$At_{n.i.k}$: k-th attribute
At_s: attribute - nutritional property
At_{sk}: attribute - content and quantity of nutritional property
At_r: attribute - ranking of significance.
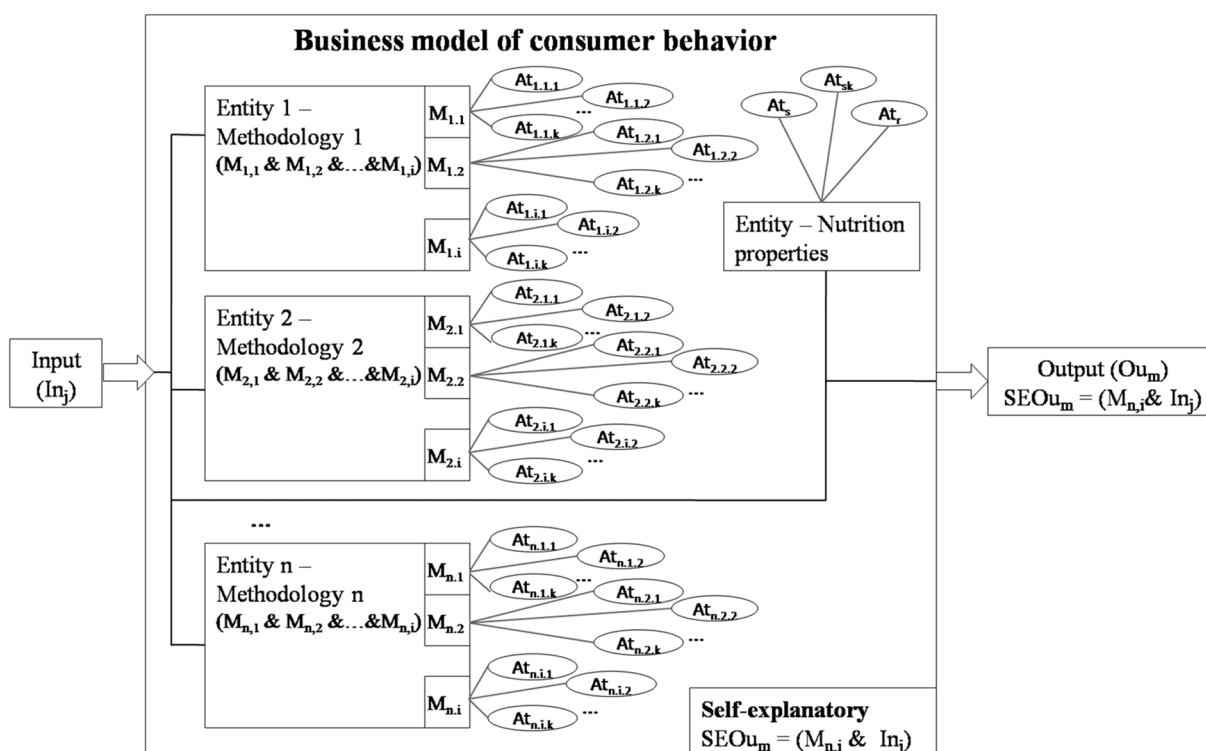$SEOu_m = (M_{n.i} \& In_j)$: Self-explanation

Figure 1. Logical structure of the business model of consumer behavior

Stage 4 - Physical model is the stage of realization of the logical model in a software solution. It is created in a software development environment, with the integration of multiple platforms. For example: integration between: GIS, DBMS (SQL) and data mining software.

Stage 5 - Verification is the final stage of modeling and it involves verifying the business model with test data. The output analyzes the output data, and this can be done very easily, because the self-explanation is returned to the model, i.e. the model explains receiving each output, so that the test check is easy and safe.

4. IMPLEMENTATION OF THE BUSINESS MODEL OF CONSUMER BEHAVIOR WITH SURVEY DATA

For the past few years, our marketing research has focused on surveys for detecting the key factors of influencing consumer behavior (Martinovski & Gulevska, 2017, Gulevska & Martinovski, 2018). A database is formed from the conducted research, and the conducted advanced analyzes result in concluding observations. To show a partial implementation of the business model of consumer behavior, we will use several of our surveys, and one of those surveys was done in R.N. Macedonia for bee honey as a food product (Martinovski & Gulevska, 2017). The main purpose of this survey is to detect attitudes about the nutritional determinants of honey and the labeling (declaration) of honey. In this research, a detailed analysis was made using the defined methods from point 3. A number of other calculations have been made and a lot of information and knowledge on consumer behavior related to the nutritional determinant of honey has been obtained; this paper demonstrates the acquisition of several results as model outputs using advanced methods. Table 2 and Figure 2 show the output (Ou_1) of the model obtained with Methodology 2 (M2.1) – a ranking-based method. Category: factors when choosing honey (rank, packaging, color of honey, taste of honey, price of honey and nutritional properties of honey).

Table 2. Output table for Ou_1 - Methodology 2 (M2.1)

Category					
Rank	Packaging	Color of honey	Taste of honey	Price of honey	Nutritional properties of honey
1	86	42	31	79	71
2	36	54	29	34	34
3	47	53	57	79	51
4	33	35	52	38	34
5	98	116	131	70	110
Ranking (Ou_1)	21%	24%	26%	7%	22%

Source: Authors
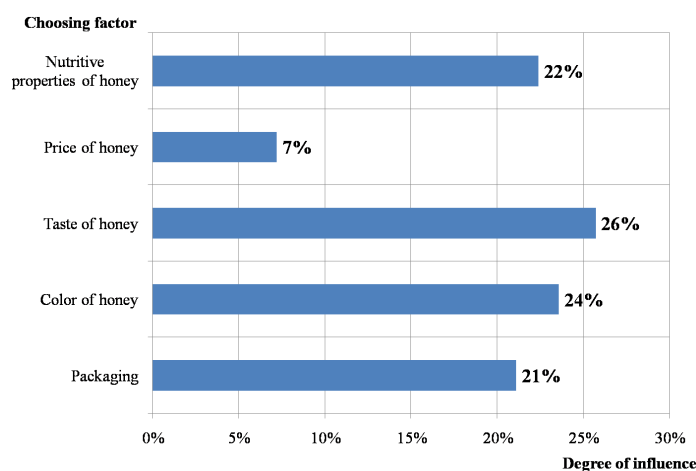
Figure 2. Graph as a model output1 (Ou_1) for ranking the most important factors when choosing honey

Tables 3, 4, 5 and 6 show the outputs Ou_4, Ou_5 and Ou_6

Methodology 3 (M2.1, M2.2) is used to obtain the outputs Ou_4, Ou_5, Ou_6.

For Ou4 (Table 3):

M2.1 (category 1: education, category 2: familiarity with the nutritional properties of honey, Chi-Square test, Cramer's V test)

Table 3. Frequency of education - familiarity with the nutritional properties of honey and results of Chi-Square and Cramer's V tests.

Q8. Are you familiar with the nutritive properties of honey?				
Education	Yes	No	Partially	Total
High School	8	60	14	82
Bachelors or Master's or PhD	55	84	79	218
				300

Chi-Square	df	α	p	Cramer's V
28,75	2	0,05	<0.0001	0.3096

Source: Authors

Model output: p<α which means that **there is a statistical dependence** between the categorical variables, i.e. education and whether they are familiar with the nutritive properties of honey are **statistically dependent**, and the value of Cramer's V is 0,3096 which shows that this dependence is moderate.

For Ou4 (Table 4):

M2.1 (category 1: education, category 2: familiarity with the benefits of honey for human nutrition, Chi-Square test, Cramer's V test)

Table 4. Frequency of education - familiarity with the benefits of honey
for human nutrition and results of Chi-Square and Cramer's V tests.

Q7. Are you familiar with the benefits of honey as a food for humans?				
Education	Yes	No	Partially	Total
High School	28	5	49	82
Bachelors or Master's or PhD	124	13	81	218
				300

Chi-Square	df	α	p	Cramer's V
13,31	2	0,05	0,0013	0,2106

Source: Authors

Explanation: p<α which means that **there is a statistical dependence** between the categorical variables, i.e. education and whether they are familiar with the benefits of honey are **statistically dependent**, and the value of Cramer's V is 0,2106 which shows that this dependence is small.

For Ou_5 (Table 5):

M2.1 (category 1: gender, category 2: familiarity with the nutritional properties of honey, Chi-Square test, Cramer's V test)

Table 5. Frequency of gender - familiarity with the nutritional properties of honey
and results of Chi-Square and Cramer's V tests.

Q8. Are you familiar with the nutritive properties of honey?				
Gender	Yes	No	Partially	Total
Male	21	83	43	82
Female	42	61	50	218
				300

Chi-Square	df	α	p	Cramer's V
10,77	2	0,05	0,0046	0,1895

Source: Authors

Explanation: p<α which means that there is a **statistical dependence** between the categorical variables, i.e. gender and whether they are familiar with the nutritional properties of honey are **statistically dependent**, and the value of Cramer's V is 0,1895 which shows that this dependence is small.

For Ou_6(Table 6):

M2.1 (category 1: age, category 2: familiarity with the nutritional properties of honey, Chi-Square test, Cramer's V test)

Table 6. Frequency of age - familiarity with the nutritional properties of honey and results of Chi-Square and Cramer's V tests.

Q8. Are you familiar with the nutritive properties of honey?				
Age	Yes	No	Partially	Total
From 25 to 40 years.	25	37	21	83
From 25 to 40 years.	23	84	53	160
Over 55 years.	15	23	19	57
				300

Chi-Square	df	α	p	Cramer's V
10,17	4	0,05	0,0387	0,1377

Source: Authors

Explanation: $p < \alpha$ which means that there is a **statistical dependence** between the categorical variables, i.e. age and whether they are familiar with the nutritional properties of honey are **statistically dependent**, and the value of Cramer's V is 0,1377 which shows that this dependence is small.

In another survey on the impact of nutritional properties of food products on consumer purchasing decisions, using the Partitioning Clustering Method, a cluster was obtained (Figure 3) of respondents who answered yes to the questions:

1Q. It is important for me to consume healthy food.
2Q. I think I have knowledge about the nutritional characteristics of food products.
3Q. I consider that I can recognize the importance of the nutritional characteristics listed on the food product declarations.

Of the total number of respondents (400), 55% answered these questions with "yes" as set pattern 1. 1Q (yes) - 2Q (yes) - 3Q (yes).
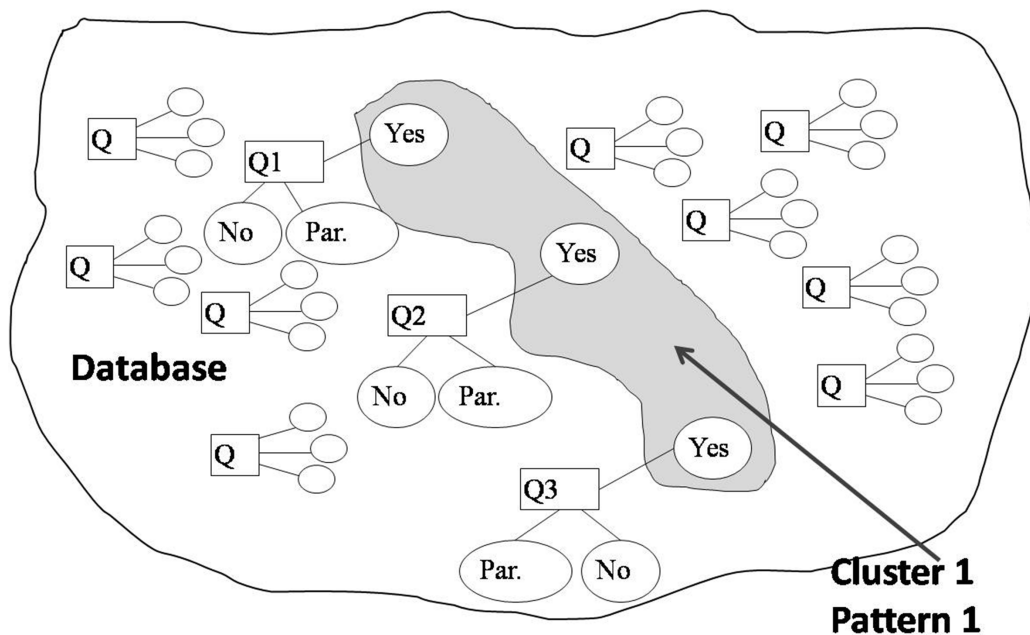

Figure 3. Cluster of respondents who answered "yes" to questions 1, 2 and 3.

A cluster is an output of a model that is represented in graphical or analytical form. The information obtained from the model is that there is a cluster of consumers who have knowledge of the nutritional characteristics of food products and they influence them when buying.

The self-explanation of the output model is: $SEOu_m = (M_{n,i} \& In_j)$. For example, for Ou_1, $SEOu_1 = (M_{2,1}$-Ranking based method, In_1- survey research in R.N. Macedonia) by explaining the method based on ranking by category, for example for packaging:

Package (%) = SUM (frequency$_1$* rank$_1$) / SUM (SUM (frequency$_1$* rank$_1$); SUM (frequency$_2$* rank$_2$); SUM (frequency$_{)3}$* rank$_3$); SUM (frequency$_4$* rank$_4$); SUM (frequency$_5$* rank$_5$))) * 100

5. CONCLUSION

For companies in the food industry it is important to apply the concept of modeling that is presented in the paper to create a business model of consumer behavior with the inclusion of nutritional determinants. The main purpose of this model is to detect all factors influencing consumer behavior in the field of food and nutrition. Similarly, the model can determine the impact on consumer behavior of foods with improved nutritional quality, by emphasizing the components that affect human well-being and health. In building these models, it is important to use advanced scientific methods set up as entities in a relationship, which will enable the acquisition of important information and knowledge. The relationship of the entities will allow for a self-explanation of the model which is in other models reduced to help only.

The business model of consumer behavior with included nutritional determinant is an important part of the business of companies whose activity is food products, and it will enable the expansion and strengthening of their brands as a healthy diet. The benefits of nutritional business models of consumer behavior can be multifold: benefits for companies through the development of new food products with added nutritional value that would satisfy consumers, and thus greater profit for the companies; benefit for the citizens by consuming healthier and safer food products, etc.

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