



THE ROLE OF MILL -AND BAKERY-PRODUCTS MADE FROM CEREALS AS FUNCTIONAL FOODS IN HEALTH IMPROVEMENT

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SUMMARY

This manuscript focuses on cereals, and the mill and bakery products made from them, as functional foods and their impact on health. Our quantitative study was conducted using a questionnaire consisting of 21 closed questions, which were divided into four groups of statistical activities. We first measured demographic data, then focused on health status, knowledge of concepts and assessment of consumer needs. For the statistical evaluation of our survey we performed a normality test (Kolmogorov-Smirnov and Shapiro-Wilk test), a descriptive statistical analysis, a demographic distribution and correlation test which was evaluated in Microsoft Excel and IBM SPSS Statistics 26. The number of respondents was $n=103$, of which $n_m=45$ were men and $n_w=58$ women. Following the baseline evaluation of our results, we performed a correlation study, during which we discovered a positive correlation between age and how many grains the respondent would try ($p=0.041$). According to this, older consumers are more interested in the diversity of cereals. Our research can also provide a suggestion to marketing experts that it is worth presenting the diversity of cereals to the older consumer group, and thus increasing the rate of profit.

Keywords: cereals, mill -and bakery-industry, functional foods, healthy lifestyle, health promotion

INTRODUCTION

Some specific classes of functional foods (*Csapó & Albert, 2018*) have already been given by many nations, however there is not an exact definition, unlike the definition of organic foods. We can determine the factors that impact the functional properties of a food (like positive physiological effect, research results, daily nutritional adaptation). Functional foods always fulfil a special function in the human body. Therefore, they have outstanding effects on stimulating defence mechanisms, preventing diseases, promoting healing, increasing physical and mental power, and slowing down or completely inhibiting the ageing process of the organism. Of course, the attribution of these products with medicinal properties is still excluded (*Ashaolu, 2020*). Functional foods could be distinguished by their origin, the method of their production and the effects they have on our health. When grouping by origin, foods of animal origin and vegetable foods could be distinguished. Accordingly, foods, ingredients and their physiologically active agents can be distinguished. Despite the fact that using this way of grouping we can see several components that have a function, which can be found in both categories, their utilization and absorption may be different (*Nagy et al., 2008*). The second way of grouping we can use is the method of production. It refers to three further groups as follows: whole foods / raw materials with added ingredients, fortified foods with added nutritional value and genuine functional foods. Functional products also have a role in protecting our organ systems and in health promotion and in disease prevention (*Nagy et al., 2008*). Furthermore, the third way of grouping analyses their effects on the physiological functioning of the human body. Opportunities for developing functional foods can also form part of specialized articles (*Alongi & Anese, 2021; Tadesse & Emire, 2020; Rashwan et al., 2020*). Food companies have several different opportunities for the development of the production of functional foods. The most commonly used method is fortification, in which they increase the amount of different nutrients in certain food (*Nagy et al., 2008*).

The basic food groups found in the nutrition pyramid and in OKOSTÁNYÉR (new Hungarian nutritional recommendation) are the determining elements of healthy nutrition (*Bencsik & Labáth, 2000; URL₁: <http://www.okostanyer.hu/>*). They can be considered as functional foods due to their excellent nutritious values, therefore significantly contributing to the well-being of consumers.

Cereals are the basis of a healthy diet. Cereals include, among other things, wheat, rye, barley and oats. Wheat is one of the best known grains, and the mill and bakery products made from it are also the most commonly used functional foods. Whole wheat also contains bran and germ as well as higher amounts of fiber, polyphenols, vitamins and minerals. These physiologically active substances prevent a rapid increase in blood sugar levels and also reducing the development of diabetes. They also contribute to the prevention of intestinal diseases, heart disease and obesity (Kimbell, 2018; Munkácsi, 2018). Numerous studies report on their research yields achieved through foliar treatment of winter wheat. Yields and content values of winter wheat treated with different copper-containing complexes developed favorably. Szakál, 2021; Szakál et al., 2021; Giczi et al., 2020; Szakál et al., 2012). Rye is a characteristic deep-tasting cereal variety that is a descendant of a wild plant variety grown as weeds in wheat and barley fields. Rye bread is denser than wheat because it holds less gases inside during fermentation. When grinding rye, it is difficult to separate the germ and the bran, so more nutrients remain in the rye flour than in the wheat flour. In addition, it has a higher fiber content and phytonutrient content (Kimbell, 2018). Barley was historically used in ancient Egypt to make bread and beer, and the diet of Roman gladiators also contained large amounts of grain. In many cases it was grown together with other common wheat (stump, einkorn wheat). It grows well in cool conditions so it is perfectly suited to temperate areas and countries. Barley is rich in fiber vitamins B, minerals and protein. It can be used for baking, a number of ways, whether ground into flour, added as a germinated seed to the dough, or as a malt extract. It is also the main raw material for brewing and distilling. It has been bred for thousands of years and today a wide variety of barley is grown. Six-row barley is used in northern Scotland, two-row barley is used in brewing, while black barley from Ethiopia is a tasty, nutrient-rich ingredient (Kimbell, 2018). Oats contain significant amounts of beta-glucans. They decrease the body's cholesterol levels by preventing it from being absorbed in the intestines into the bloodstream. Beta-glucans also slow down the rate of starch digestion and keeping blood sugar levels more balanced. Oat consumption plays a prominent role in international gastronomy. It is also ground into flour, as a stand-alone food or during food preparation (Kimbell, 2018). A wide range of products made from cereals including flours, pasta, muesli, cereals, puffed goods are also available to consumers. Cereal foods are a significant source of energy and carbohydrates. They also help meet the body's need for protein, vitamins and minerals.

Their fat content is negligible but fats added during cooking and food production can also increase the fat content of the product made from them. Their consumption also plays an important role to provide daily protein needs. Consumption of whole-grain, high-fiber foods reduces the chances of developing intestinal disorders, cardiovascular-disease, and type 2 diabetes. Furthermore, dietary fiber also increases the saturation value of foods. The products of the mill and bakery industry also provide vitamins (for example: E, B₁, B₂, B₃, B₆) and minerals (for example: calcium, magnesium and zinc) to the body (Rodler, 2005).

In addition to cereals, the regular consumption of vegetables and fruits are an essential element of a healthy diet (Guan *et al.*, 2021; Zeinstra *et al.*, 2021; Schauder *et al.*, 2020). These products play a significant role in maintaining health due to their variety and nutrients. Most of them are not high in energy, except for dry legumes and nuts. Their fat content is also negligible with the exception of the latter.

Most fruits and vegetables are low in carbohydrates, except for a few, such as dry legumes, potatoes, chestnuts, bananas, and some nuts. Their greatest value lies in the dietary fiber content (pectin). Dietary fiber in vegetables and fruits inhibits the absorption of fats and cholesterol. They also contain many vitamins (for example: vitamins B₁, B₂, B₆, C, K, E), folic acid and carotenoids, potassium, magnesium and calcium but their iron content is poorly utilized in the body without animal-derived protein. Useful antioxidants in vegetables and fruits also inhibit the development of atherosclerosis and cancer. Furthermore, their fluid content complements the recommended daily intake of water, thereby promoting digestion (Rodler, 2005).

The group of milk and dairy products are also a valuable part of the diet and their consumption is recommended every day (Rodler, 2005). Milk, milk drinks, fermented dairy products - yoghurt, kefir, buttermilk - cottage cheese and cheeses as well as whey from cheese-making and sour cream, cream and butter also belong to this group. Milk and dairy products are the richest sources of calcium, as half a liter of these products cover 60-70% of your daily calcium needs. Furthermore, among children, adolescents and the elderly, their consumption requires special attention because of their vitamin D, A, B₁, B₂, and B₁₂, magnesium, and zinc content as well. The protein content of these products has excellent quality and is well utilized. The fat content of milk can vary and several products are available to consumers but the carbohydrate content is insignificant (5 g sugar / 1 dl milk) (Rodler, 2005). There is more and more literature regarding the

beneficial effect of products containing lactic acid bacteria in maintaining the intestinal flora, as well as killing incoming and multiplying pathogens and helping the immune system (*Aljutaily et al.*, 2020).

Meats and meat products (poultry, pork, beef, veal, horses, sheep, goats, game, offal), fish and eggs are key determinants of a healthy diet due to their complex protein content. In addition to the significant protein content of meats and meat products, some vitamins and minerals are also absorbed into the body. Furthermore, their content of vitamin B₆, zinc and iron are also significant. The liver is outstanding among the viscera, as it is rich in vitamins (vitamin A) and minerals, however, its consumption is recommended every 10-14 days. In addition to the liver, the cholesterol content of the heart, lungs and kidneys are also outstanding and their consumption should be avoided in case of high cholesterol levels (*Rodler*, 2005). The protein content of the egg is not high, but its composition is very valuable and its utilization is excellent as well (*Pal & Molnár*, 2021). Egg yolk has a high cholesterol content (220-240 mg) so it is recommended to reduce its consumption in people diagnosed with high cholesterol (*Rodler*, 2005).

Sea fish also play an important role in healthy eating and in different diets (Mediterranean diet). (*Molnár & Pal*, 2020). The protein content of sea fish is the same as that of meat. Some fish are low in fat so consuming them as part of a healthy diet is recommended. Its best-known representatives are cod, heck and flounder. Omega-3 fatty acids also play a significant role in prevention. They reduce blood triglyceride levels, inflammation, inhibit blood clots, irregular heartbeat and help balance the immune system. These beneficial effects have already been observed following the consumption one portion a week. The vitamin content of fish meat is excellent. Furthermore, it is also rich in vitamins D, E and B. Its consumption also contributes to the body's supply of calcium, magnesium, iron and zinc (*Rodler*, 2005). However, there are also foods that are rarely or moderately advised to be consumed. These include fats, foods high in salt and sugar and alcohol (*Rodler*, 2005).

The primary purpose of our manuscript is to provide an overview of the consumer needs and health benefits of cereals and the mill and bakery products made from them as functional foods. Furthermore, after evaluating our results, we formulate proposals that can be used in practice, taking into account the health-promoting effects of cereals.

MATERIAL AND METHOD

In our survey, we conducted quantitative research on a sample taken from a multi-element population. Our 21 closed-ended online questionnaire was filled out by people living in Győr-Moson-Sopron County. We considered it important that all of those taking part were regular consumers of cereals and baked goods. Our sample can be said to be representative of the population. In the quantitative study, we focused on 4 groups of statistical activities, which were demographic data, health status, knowledge of concepts, and consumer demand survey.

Our results were evaluated in IBM SPSS Statistics 26 and Microsoft Excel software during which normality analysis (Kolmogorov-Smirnov and Shapiro-Wilk test), frequency histograms, tabular presentation of distributions, descriptive statistical analysis, correlation and regression analysis were performed. After a baseline evaluation of our results, we searched for correlations between health status development, knowledge of cereal-related concepts, grain consumption needs assessments, knowledge of the beneficial effects of grain consumption and age. The normality test is a condition for certain correlation tests. Since this condition was met, correlation and regression studies could also be performed.

RESULTS AND EVALUATIONS

Findings for the complete sample

The total number of persons completing the questionnaire was $n=103$, of which $n_m=45$ men and $n_w=58$ women. In terms of age distribution, the number of participants aged 21-30 was 28, the number of participants aged 31-40 was 35, those aged 41-50 was 15, those aged 51-60 was 17, and there were 8 people in the 60-70 category. Most of the respondents live in cities, a total of $n_c=41$ people, and most of them were single, the exact number being $n_s=56$ people. Furthermore, most of them graduated from college with a total of 34 people and earning between HUF 200,001-250,000 based on income.

At first, we performed the empirical analysis. Based on this, the aggregation of participants' health status, health awareness and need for a healthy diet by health scores was as follows. 1 person scored 0 points, 20 people scored 1 point, 51 people scored 2

points, 31 people scored 3 points according to their own statements on health-related issues (*Table 1*). The answers to each question may also be of interest to us. 82 people stated that they pay attention to nutrition, 81 people thought they were thinking health-consciously but only 52 people stated that they did not suffer from diseases (*Figure 1*).

Table 1: Assessment of health status among participants

The sum of health-points					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0	1	1.0	1.0	1.0
	1	20	19.4	19.4	20.4
	2	51	49.5	49.5	69.9
	3	31	30.1	30.1	100.0
	Total	103	100.0	100.0	

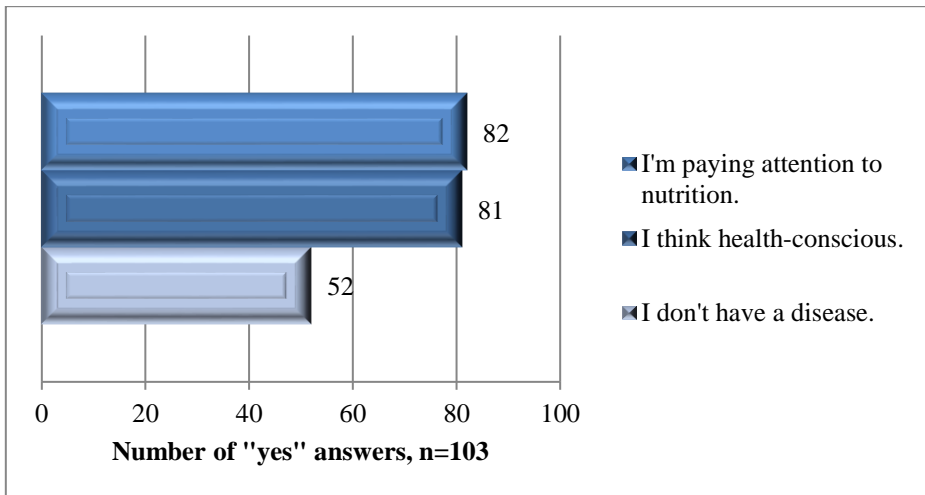


Figure 1: The elements of health assessment

We also considered it important to assess knowledge of concepts related to cereals, which is summarized in *Table 2*. Most commenters knew the answers to all six questions. 2 people answered yes to three questions, 14 people answered four questions, 38 people answered five questions and 49 people answered six questions. *Figure 2* shows the

elements of grain-related knowledge. Knowledge of the concepts of grain, flour and bakery products is complete for more than 90 people, but only 88 people know different cereals, 90 different flours and 86 bakery products.

Table 2: Summary of knowledge related to the concept of cereals

Knowledge of concepts.					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	2	1.9	1.9	1.9
	4	14	13.6	13.6	15.5
	5	38	36.9	36.9	52.4
	6	49	47.6	47.6	100.0
	Total	103	100.0	100.0	

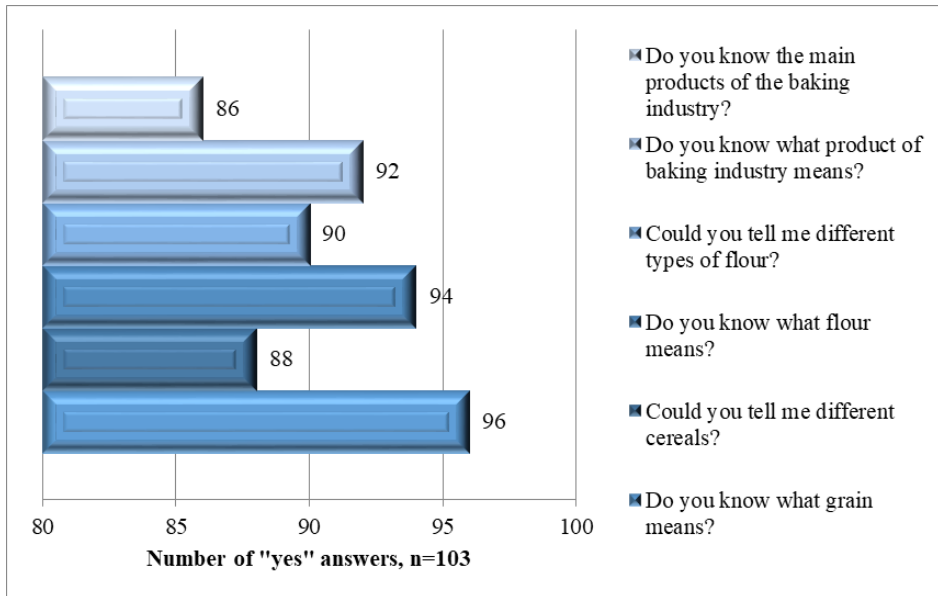


Figure 2: The elements of conceptual knowledge related to cereals

During the consumer demand surveys, we also asked participants how many types of cereals they would like to try. Respondents were able to mark more than one grain.

Therefore, it is advisable to make a summary here as well. The answers to our question were divisive, the exact illustration of which is shown in *Table 3*. The “yes” answers were aggregated and most (35 people) would also try three of the ones listed. There was 1 respondent who was interested in up to eight types of grain. Furthermore, *Figure 3* shows that the greatest interest is elicited by spelled with 36 markings, with 32-32 markings given equally to buckwheat and einkorn wheat. Consumers are least interested in barley.

Table 3: How many cereals would you like to try?

		How many types of cereals would you try?			
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	18	17.5	17.5	17.5
	2	30	29.1	29.1	46.6
	3	35	34.0	34.0	80.6
	4	12	11.7	11.7	92.2
	5	6	5.8	5.8	98.1
	6	1	1.0	1.0	99.0
	8	1	1.0	1.0	100.0
	Total	103	100.0	100.0	

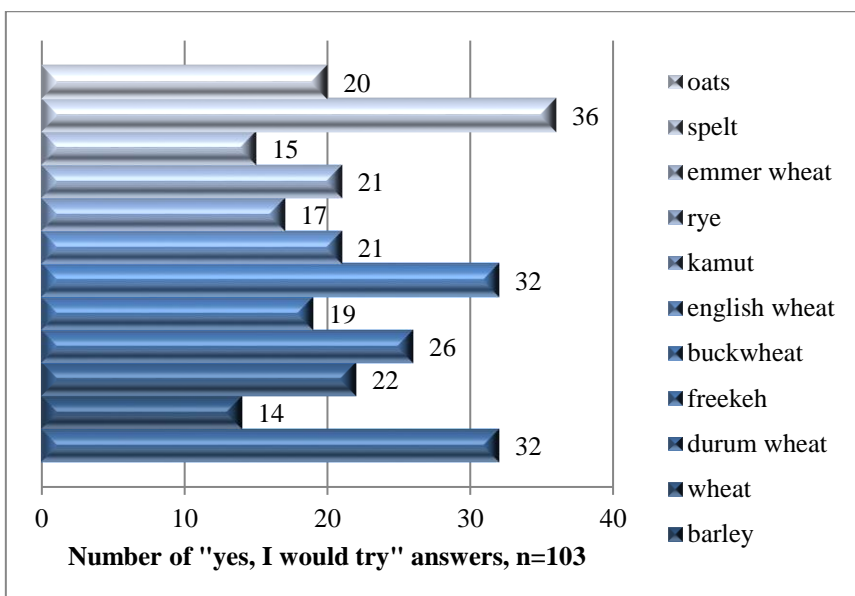


Figure 3: Summary of individual testing intentions for cereals

According to Figure 4, 5% of potential consumers want to buy high-fiber cereals unprocessed, 54% as mill and 41% as bakery and pasta products. This means that most people want to experience what they can make at home from flours and other grain mills.

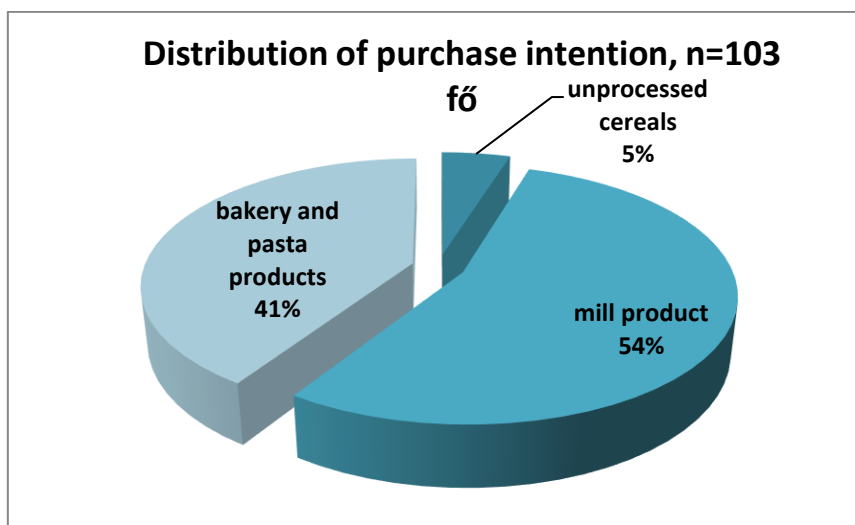


Figure 4: What form would you buy high-fiber grain?

Our other questions concerned the health effects of cereals. Participants were able to mark multiple responses but as shown in *Table 4*, the majority believed that high-fiber grains were beneficial for only one type of disease. All notations are broken down into elements in *Figure 5*. This figure shows that most respondents (62 people) find it useful in case of intestinal disease. Furthermore, 43 considered it useful in type 2 diabetes and 35 in obesity. 20 would recommend it for malnutrition and 6 for cardiovascular disease.

Table 4: Number of dietary recommendations for high-fiber cereals

How many diseases are high-fiber grains useful for?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	64	62.1	62.1	62.1
	2	19	18.4	18.4	80.6
	3	15	14.6	14.6	95.1
	4	3	2.9	2.9	98.1
	5	2	1.9	1.9	100.0
	Total	103	100.0	100.0	

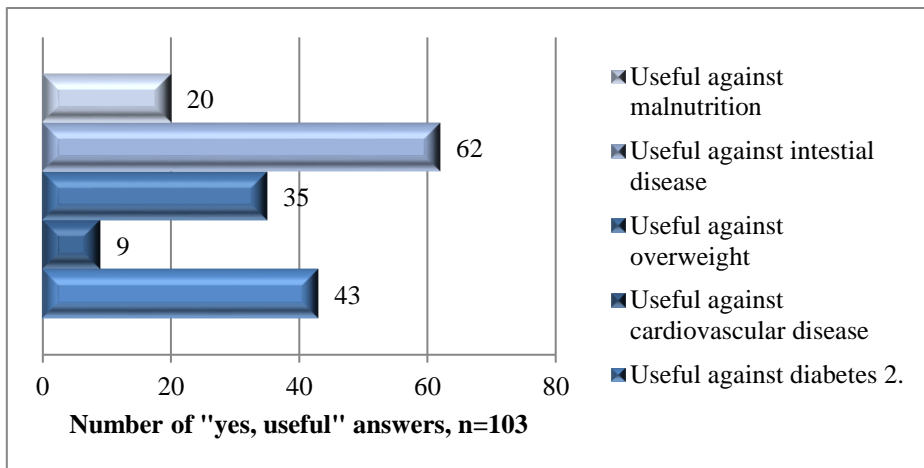


Figure 5: For what health problems it is useful?

Table 5 shows the extent to which cereals are considered functional foods on a scale of 1-10. 7.39 is the highest average which means that the majority accept the grains tested as a functional product.

Table 5: Number of dietary recommendations for high-fiber cereals

Statistics						
		How much do you consider grains to be functional foods?	How functional is the fiber content of cereal products?	How functional is the vitamin content of cereal products?	How functional is the mineral content of cereal products?	How functional is the protein content of cereal products?
N	Valid	103	103	103	103	103
	Missing	0	0	0	0	0
Mean		7.39	7.08	6.36	6.77	6.40
Median		8.00	7.00	6.00	7.00	7.00
Mode		10	6	5	8	7
Std. Deviation		2.069	1.588	1.552	1.670	1.711
Minimum		1	4	2	4	2
Maximum		10	10	10	9	10

The empirical analysis can conclude that 99 out of 103 respondents would be willing to accept advice from a nutritionist.

Result of Normality -and Correlation-Test

We also performed a normality test during the evaluation of our results. Based on this, we found a normal distribution for the answers to all our questions which was proved by the Kolmogorov-Smirnov test and the Shapiro-Wilk test. After evaluating the responses to our key questions for the entire sample, we conducted a correlation study to find the strongest correlations between each factor. Such factors included gender, age, education, size of residence, and income. Comparing these factors with the willingness to try cereals, we found a significant relationship between age and willingness to try cereals ($r=0.172$; $p=0.041$). It is almost evident that there is also a significant correlation between income and willingness to try cereals ($r=0.187$; $p=0.029$). However, a regression line can only be fitted for age and the types of cereals to be tested, these variables are metric. $y=1.64+0.025x$ a regression line can be fitted, where y is the number of cereals varieties

to be tested and x is the age of the respondent. Both parameters are significant (*Tables 6 and 7*).

Table 6: Correlation matrix, demographics and number of cereals to be tested

Coefficients^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.640	.432		3.795	.000
	Age of respondent	.025	.010	.240	2.480	.015

^a Dependent Variable: How many types of cereals would you try?

Table 7: Regression analysis, age and cereal varieties to be tested

		Age of respondent	Gender of the respondent	Highest level of education	Type of residence	Income interval	How many types of cereals would you try?
Age of respondent	Correlation Coefficient	1.000	0.039	-.187*	0.059	.191*	.172*
	Sig. (1-tailed)		0.347	0.029	0.275	0.027	0.041
	N	103	103	103	103	103	103
Gender of the respondent	Correlation Coefficient	0.039	1.000	.165*	.184*	-0.006	-0.020
	Sig. (1-tailed)	0.347		0.048	0.032	0.478	0.419
	N	103	103	103	103	103	103
Highest level of education	Correlation Coefficient	-.187*	.165*	1.000	0.028	.219*	-0.157
	Sig. (1-tailed)	0.029	0.048		0.389	0.013	0.057
	N	103	103	103	103	103	103
Type of residence	Correlation Coefficient	0.059	.184*	0.028	1.000	-0.034	0.116
	Sig. (1-tailed)	0.275	0.032	0.389		0.366	0.122
	N	103	103	103	103	103	103
Income interval	Correlation Coefficient	.191*	-0.006	.219*	-0.034	1.000	.187*
	Sig. (1-tailed)	0.027	0.478	0.013	0.366		0.029
	N	103	103	103	103	103	103
How many types of cereals would you try?	Correlation Coefficient	.172*	-0.020	-0.157	0.116	.187*	1.000
	Sig. (1-tailed)	0.041	0.419	0.057	0.122	0.029	
	N	103	103	103	103	103	103

CONCLUSION AND RECOMMENDATIONS

In our research, we obtained an overview (n=103 people) of the distribution of the demographic sample, health status, conceptual knowledge, and the distribution of grain consumption among the participants. This revealed that the majority of respondents recognized the beneficial effect of the high fiber content of cereals. Furthermore, this beneficial component would be utilized by most people with intestinal diseases (n=62). As a consequence of the correlation and regression analysis, we can say that the age of consumers significantly influences the interest in the variety of cereal products (p=0.041). With our research, we can also help the work of marketing experts by suggesting that it is worth presenting the diversity of cereals to older consumer groups as this would increase the rate of profit. However, a more accurate mapping of this requires further research.

GABONÁKBÓL ELŐÁLLÍTOTT MALOM- ÉS SÜTŐ-IPARI TERMÉKEK, MINT FUNKCIONÁLIS ÉLELMISZEREK SZEREPE AZ EGÉSZSÉGFEJLESZTÉSBEN

MOLNÁR JUDIT - VASAS DÁVID

Széchenyi István Egyetem, Mezőgazdaság – és Élelmiszertudományi Kar

Víz -és Környezettudományi Tanszék

Mosonmagyaróvár

ÖSSZEFOGLALÁS

Kéziratunk középpontjában a gabonák illetve azokból előállított malom-és sütő-ipari termékek, mint funkcionális élelmiszerek és egészségre gyakorolt hatásuk áll. Kvantitatív vizsgálatunkat 21 zárt kérdésből álló kérdőív segítségével végeztük el, amit négy statisztikai tevékenységcsoportra bontottunk. Elsőként a demográfiai adatokat mértük fel, majd pedig az egészségi állapotra, fogalmak ismeretére és fogyasztói igények felmérésére fókuszáltunk. Felmérésünk statisztikai értékeléséhez normalitás vizsgálatot (Kolmogorov-Smirnov és Shapiro-Wilk teszt), leíró statisztikai elemzést, demográfiai megoszlás- és korreláció vizsgálatot végeztünk, melyet Microsoft Excel és IBM SPSS

Statistics 26 programban értékeltünk ki. A kérdőívet kitöltők száma $n=103$ fő, amelyből $n_f=45$ fő férfi és $n_n=58$ fő nő. Eredményeink alapértékelését követően, a korreláció-elemzés során pozitív korrelációt fedeztünk fel az életkor és aközött, hogy hányféle gabonát próbálna ki a megkérdezett ($p=0,041$). Ennek értelmében, minél idősebbek a válaszadók, annál jobban érdeklődnek a gabonafélék sokfélesége iránt. Kutatásunk a marketing-szakértők részére is javaslattal szolgálhat, miszerint érdemes a gabonafélék sokféleségét az idősebb fogyasztói réteg felé prezentálni, ezzel is növelve a nyereség mértékét.

Kulcsszavak: gabonák, malom-és sütő-ipar, funkcionális élelmiszerek, egészséges életmód, egészségfejlesztés

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