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Assessment of sensory preference and frequency of carbohydrate bar consumption by physically active people Ocena preferencji sensorycznych i częstość spożycia batonów węglowodanowych przez osoby o zwiększonej aktywności fizycznej

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Abstract

Introduction: Active lifestyles are causing an increase in interest directed toward foods, many athletes use specially formulated food products that concentrate large amounts of nutrients in a small volume, while also being easily digestible and quickly absorbed. The main objective of the study was to compare selected commercially available products prepared for physically active people with those prepared based on proprietary recipes and natural, commonly available ingredients. **Material and method:** The material used in the comparative study was energy bars from three sources: popular market bars from the leading manufacturers in the Polish market and available in most grocery stores, specialized bars, and bars made according to the author's recipe in imitation of the above snacks using natural ingredients. The evaluation of the use of supplements was based on the author's survey questionnaire on consumer preferences and frequency of consumption of carbohydrate products, using energy bars as an example. **Results:** Bars prepared according to the author's recipe received scores of 2 and 3 for taste and texture and scores of 1 and 2 for the input of basic raw materials. Evaluation of the use of supplements was carried out in a group of 147 people, the study group was dominated by people who train in cycling and running. About 65% of the respondents declared that they use energy bars. Among those who use energy bars, the largest number of respondents declared that they use specialty bars (20%), 15% of respondents use market bars and 8% make the bars themselves. **Conclusions:** The results of

the sensory evaluation of bars prepared according to the author's recipe indicate the need to modify their composition, especially in terms of improving the texture. Carbohydrate supplements are used by respondents, especially if it is justified in the case of practicing endurance and endurance sports characterized by high intensity of training, i.e. cycling and running.

Keywords: physical activity, energy bars, supplements

Introduction

Active lifestyles are causing an increase in interest directed toward foods to influence both the health and fitness development of athletes. Physically active people are a group with specific nutritional needs, the most important of which is an increased need for energy [1]. Due to their increased physical exertion, active athletes are at risk of nutritional deficiencies that can lead to decreased physical performance and general health deterioration. For this reason, many athletes turn to specially formulated food products that concentrate large amounts of nutrients in a small volume, while also being easily digestible and quickly absorbed [2]. Today, many forms of carbohydrate supplements are commercially available, depending on the form preferred by the consumer, including beverages, jellies, gels, in powder form or bars [3]. Dietary carbohydrates are one of the main sources of energy used by the human body. An adequate supply of carbohydrates in the diet has a significant impact on the performance of the body during exercise and on the post-exercise recovery period [4]. Cereal products are the main, most common source of complex carbohydrates, and thus an easily digestible source of energy, which ranges from 231 to 391 kcal/100g of product. Cereals are also a rich source of plant protein, vitamins, and minerals [5].

Since the rise of interest in physical activity, proper nutrition has become an integral part of physical fitness. The understanding of metabolism and exercise physiology is aimed at developing nutritional strategies to positively influence athletic performance. This premise has led to the development of the popularity of supplements among athletes at various levels of activity, from that undertaken for leisure, entertainment, or recreation, to the professional commercial form [6].

In low-activity individuals with a well-balanced diet, carbohydrate supply should be sufficient to maintain energy balance, but in physically active individuals it can be difficult to meet energy needs, particularly for high-intensity training. Negative energy balance is common among endurance athletes such as runners, cyclists, and swimmers, but also in sports where dietary restrictions are part of nutritional strategies aimed at, for example, weight modification (martial arts, artistic gymnastics, ice skating, etc.) [7].

Cereal energy bars are the products most often reached for by athletes, but they have also gained their popularity among people with low physical activity [8]. These bars are products with high nutritional value while maintaining a good taste and flavor of the product. Energy bars are a source of valuable complex carbohydrates as well as dietary fiber or B vitamins [9]. There is a wide range of energy bars available on the food market, designed specifically for athletes, as well as cereal bars, which are often used as meal replacements.

Aim

The main objective of the study was to compare selected commercially available products prepared for physically active people with those prepared based on proprietary recipes and natural, commonly available ingredients.

Material and methods

The material used in the comparative study was energy bars from three sources: popular market bars from the leading manufacturers on the Polish market and available in most grocery stores, specialty (sports) bars, and bars made according to the author's recipe along the lines of the above snacks using natural ingredients. All bars were divided into three

flavor groups: nut, chocolate, and fruit. The bars were compared in terms of composition and nutritional value, their sensory evaluation was carried out, and consumer preferences for the consumption of carbohydrate products were studied using energy bars as an example. Consumer preferences were assessed in a group of 116 men and 31 women.

Preparation of a proprietary energy bar

The proprietary energy bars were developed along the lines of market bars in terms of taste and similar nutritional values. The preparation of the bars was divided into 3 stages, according to the order in which the ingredients were added.

In the first stage, using a kitchen scale, all the ingredients used to make the bars were weighed. Oatmeal and rye flakes were lightly roasted in a dry Teflon pan, and all additional ingredients were prepared according to the recipe:

(a) nut bar: nuts and seeds were chopped into smaller pieces

(b) chocolate bar: dark chocolate was crushed

(c) fruit bar: dried fruits were drenched in boiling water, let stand for 10 minutes, and then cut into smaller pieces.

Additional ingredients were mixed with roasted oatmeal and rye flakes.

In the second stage, unsweetened condensed milk, honey, and chocolate for the chocolate bar were dissolved and mixed over low heat. The dissolved mixture was poured over the previously prepared dry ingredients and the bar ingredients were mixed for about a minute over low heat. In the final step, the bars were baked at 180°C for 15 minutes. The appearance of the author's energy bars is shown in Figure 1.



Fig. 1. Author's energy bars: nut, chocolate, fruit

Sensory evaluation

The sensory study included a 117-person group of undergraduate students majoring in dietetics. The subjects were a group of men and women aged 19-22. The subjects were informed of the possibility of food allergens in the samples tested.

Sensory evaluation was carried out in a sensory analysis laboratory that meets the requirements of PN-EN ISO 8589:2010 Sensory analysis - general guidelines for the design of sensory analysis laboratories [10]. All 9 samples were evaluated in 3 flavor groups: nut, chocolate, and fruit, with 3 bar samples per each group: popular market bar, specialty bar and author's bar. The bar samples were presented on an odorless white plastic plate at ambient temperature with a three-digit random number code assigned to each sample. All samples from one flavor range were presented at one time, and the order of the samples was determined by the order listed on the evaluation sheets.

The sensory analysis method used was the ranking method (order method), where the evaluator's task is to rank the samples given in random order in descending order of: taste, texture (hardness), and flavor input content. The sample with the most desirable

characteristics was ranked first and received 3 points, the second most suitable sample received 2 points, while the least suitable sample received 1 point. The place of each sample in the ranking, given by the evaluators, was then summed up, where the resulting sum of ranks determined the overall order of the samples. The analysis was performed in accordance with ISO 8587:2006 [11].

Assessment of nutritional value

The nutritional values of the author's energy bar were calculated using the "Tables of Composition and Nutritional Value of Foods and Foods" [5], while for market and sports bars, the information provided on packaging by manufacturers was used.

Evaluation of supplement use

A questionnaire survey was conducted in a group of 147 people (31 women and 116 men) engaged in various sports.

The study was conducted based on the author's survey questionnaire on consumer preferences and frequency of consumption of carbohydrate products, using energy bars as an example. The questionnaire was made available on online sports forums.

Results

Sensory evaluation results differed among the three groups in terms of flavor, firmness, and amount of flavor input, according to the type of bars.

Table 1. Results of sensory analysis of chocolate bars.

CHOCOLATE BATONS / Characteristics assessed						
	Taste		Hardness		Contribution	
Product	Total points	Place in ranking	Total points	Place in ranking	Total points	Place in ranking
Market bar	260	1	248	2	200	3
Sports bar	226	2	254	1	256	1
Author's bar	216	3	200	3	244	2

In the group of chocolate bars evaluated, the sample characterized by the most suitable taste, according to the respondents, was the popular market bar, the second place in the ranking went to the sports bar, while the worst rated in terms of taste according to the respondents was the author's energy bar. In terms of hardness, the sports energy bar was rated best, followed by the market bar while the least suitable hardness was the bar made according to the author's recipe. In terms of flavor input, the highest rated according to respondents was the sports energy bar, followed by the author's bar, while the least suitable input was characterized by the market bar.

Table 2. Results of sensory analysis of peanut bars.

NUTRITION BATONS/ Characteristics assessed						
	Taste		Hardness		Contribution	
Produkt	Total points	Place in ranking	Total points	Place in ranking	Total points	Place in ranking
Product	209	3	241	2	247	2
Market bar	272	1	252	1	191	3
Sports bar	221	2	209	3	264	1

In the group of nut bars evaluated, according to the evaluators, the sports bar had the most suitable taste. The author's energy bar received the second-highest rating, while the market bar received the lowest rating. In terms of hardness, the sports bar scored highest, followed by the market bar in second place, while the least suitable hardness was marked by

the author's nut energy bar. The author's bar received the most points in terms of flavor input, followed by the market bar and the sports bar.

Table 3. Results of sensory analysis of fruit bars.

FRUIT BATONS/ Characteristics assessed						
	Taste		Hardness		Contribution	
Produkt	Total points	Place in ranking	Total points	Place in ranking	Total points	Place in ranking
Product	229	3	237	2	240	2
Market bar	240	1	269	1	210	3
Sports bar	233	2	196	3	252	1

In the group of fruit bars evaluated, the highest rating for taste went to the sports bar, second place went to the proprietary fruit energy bar,

and the lowest rating was given to a market bar. In terms of hardness, again the highest rating was given to the sports bar, second place was given to the market bar, and again for hardness, the worst rating was given to the proprietary fruit energy bar. In terms of the amount of input, the author's bar was rated highest, the market bar was ranked second, and the sports bar received the least points.

Evaluation of nutritional value showed differences between the energy bars compared.

The author's energy bars in each flavor version, are characterized by a relatively lower energy value per 100g of product, this is due to the fact that there are also relatively large differences in sucrose content between the tested products:

- in the nut version of the energy bars, the market bar contains about 17 times more sucrose than the author's bar, while the sports bar contains as much as 28 times more,
- in the fruit version, the author's energy bar was characterized by about 2 times less sucrose content than the market bar or the sports bar,
- in the chocolate version, the sports bar contains about 5 times more sucrose than the author's bar, and the market bar 4 times more.

A distinctive, distinguishing feature of the author's energy bars compared to other bars is the higher content of dietary fiber:

- in the peanut version, the author's energy bar slightly outperformed the market bar in terms of dietary fiber content. The sports bar contained about 2 times less fiber than either the author's bar or the market bar,
- in the fruit version, the author's energy bar was characterized by about 2 times higher dietary fiber content than the market bar or the sports bar,
- in the chocolate version, the market bar contained slightly more dietary fiber than the author's bar, but both bars outperformed the sports bar by almost 3 times due to their dietary fiber content.

The use of supplements was evaluated in a group of 147 people, the majority of respondents were men 79% (116 people), while a much smaller group was women i.e. 21% (31 people). The study group was dominated by people who train in cycling and running (Fig. 2).

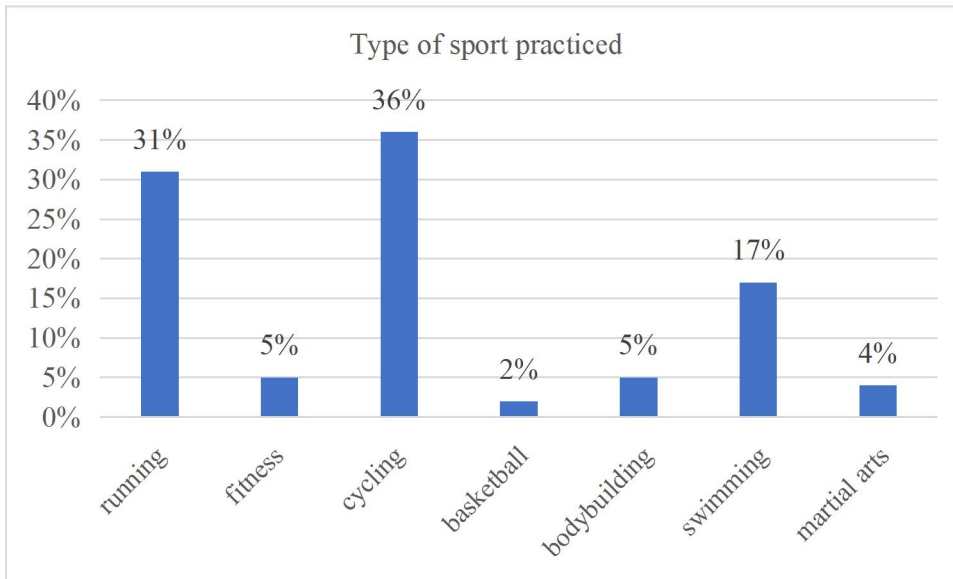


Fig. 2. Distribution of respondents by type of sport practiced

About 66% of respondents declared that they use energy bars (Fig. 3).

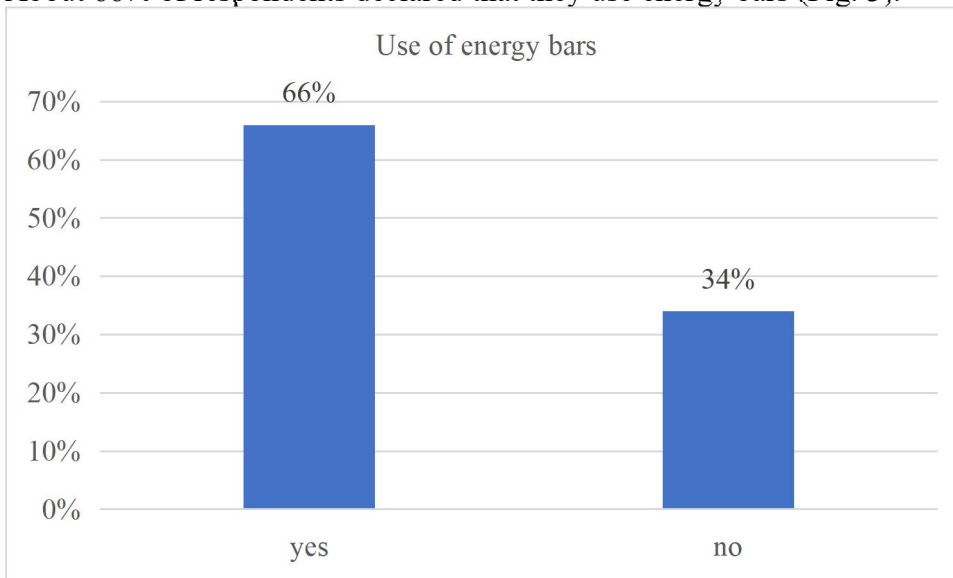


Fig. 3. Distribution of respondents by use of energy bars

Among those who use energy bars, the largest number of respondents declared that they use specialized bars (20%), 15% of respondents use market bars and 8% make the bars themselves. 11% use both market and specialty bars, 6% of respondents use specialty bars and make energy bars on their own, and about 6% of respondents consume market bars and make them on their own (Fig.4).

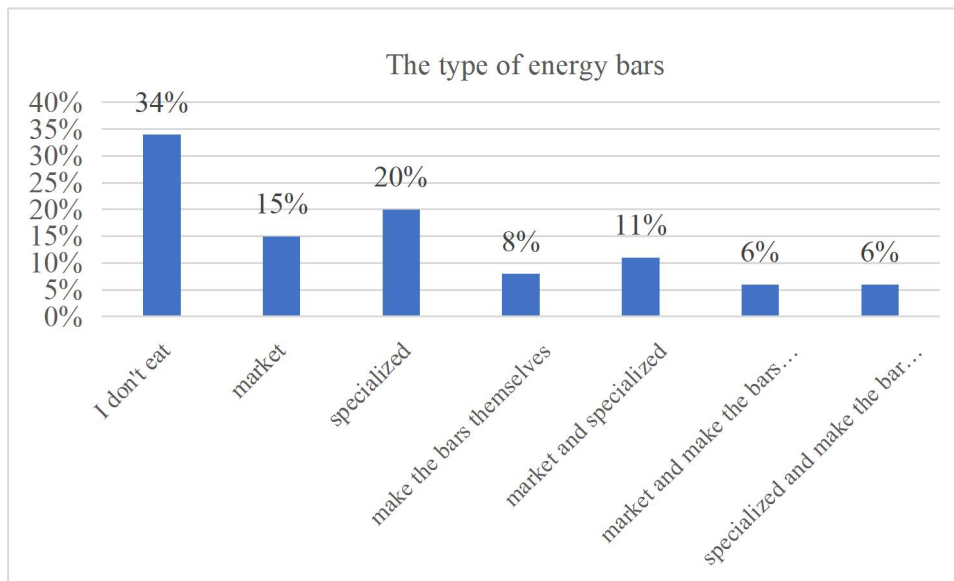


Fig. 4. Type of energy bars used

Discussion

Our own research confirms that conducting sensory analysis among consumers is a valuable source of knowledge for the manufacturer. The use of sensory surveys makes it possible to identify differences between the products studied. Sensory research also allows us to learn about the behavior and preferences that guide consumers when choosing food [13].

Sensory evaluation is one way of assessing the attractiveness of the studied product to potential buyers. In our study, three organoleptic characteristics were evaluated, namely: taste, texture (i.e. firmness), and amount of added input.

The low flavor ratings of the author's energy bars (chocolate bar - the least suitable flavor, nut bar, and fruit bar - moderately suitable) may be due to less added sugar and different texture. Energy bars according to the author's recipe were characterized by softness, rather than softness as in the case of market or specialty bars while maintaining the crunchiness of the flakes equally.

A study conducted by Aramouni and Abu-Ghoush`a showed that the structure most expected by consumers of cereal energy bars, is one that retains both the softness and crunchiness of the product. The authors also believe that soft and malleable bars are wheat-based bars whose texture is not sufficiently preferred by consumers. This was the texture of the authors' energy bars, and for this reason, they were probably rated the worst in terms of product hardness. Aramouni and Abu-Ghoush`a further showed that bars containing large amounts of glycerin (a humectant) were unfavorably rated for taste by the research panel [14]. In our own study, the glycerin content in their composition was characteristic of all market and sports bars.

In our own study, in terms of the contribution of additive ingredients, the author's peanut bar and fruit bar were rated as the bars with the most suitable additive composition, while the chocolate bar was rated as moderately suitable in terms of chocolate contribution. According to Kim et al. fruit bars in the overall pool of all bar, flavors are the least liked products, and the greater the contribution of dried fruit, the worse the rating they received [15]. However, this study is not confirmed in our own study where the author's fruit bar had the highest contribution of dried fruit among all fruit bars tested and was rated as the most preferred in terms of contribution.

In the case of nut bars, the sports bar was rated highest in terms of flavor, and differed from the others in that it was not a typical cereal bar, but covered in a large amount of chocolate caramel with a small number of cereal crisps, and also contained a higher amount of

sugar in its composition. Second place went to the proprietary nut energy bar, which stood out from the others for its higher nut content and quality. The composition of both the market bar and the sports bar was dominated by peanut content, while the author's bar contained hazelnuts and walnuts. For this reason, too, the author's peanut energy bar scored best in terms of contribution.

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The general result obtained during sensory tests proves the possibility of using proprietary natural energy bars as an alternative to market and specialist bars. Further modification of the composition, especially the improvement of the structure, would positively influence the evaluation of both the taste and the product content.

Currently, a significant change in the form of spending free time and rest can be noticed in Polish society. More and more people do sports or recreation as part of their free time. According to the reports of the Public Opinion Research Center (CBOS), as many as 61% of respondents admitted that they had practiced sports in the last year [16].

Based on the research results, it can be concluded that the most frequently practiced sport by the respondents is cycling (36%) and running (31%). CBOS research indicates that the most popular sport in Polish society is cycling (44%), followed by swimming (20%). The popularity of the above-mentioned sports may result from the financial situation of Polish society and the fact that these sports are practiced mainly for health reasons, and not as in the case of bodybuilding, where the main goal of exercise is to improve the figure [16]. The research presented above shows that endurance and endurance-strength sports predominate in Polish society, which may have consequences in the form of introducing carbohydrate supplementation into the diet.

In recent years, a statistical increase in the interest of physically active people in dietary supplementation has been observed. A study by Karpik A. et al. showed that the majority of athletes surveyed 83% use dietary supplements, with 49% of all subjects using carbohydrate supplements [17]. The study by Frączek et al. confirmed the prevalence of supplement use by physically active people, it was shown, that the majority of professional athletes (86.5%) use dietary supplements, of which 57 people (36.5% of all subjects) use carbohydrate supplements. In the author's study, the most important issue raised was the use of energy bars. In the study group, 66% of respondents said they use energy bars, while 34% said they do not. The higher result in relation to the use of carbohydrate supplements may be due to the fact that the study by Frączek et al. was dominated by athletes training team games, while the author's study was dominated by endurance athletes. The study by Frączek et al. also confirms the thesis that carbohydrate supplements are used mainly in high-intensity endurance sports,

as their use was confirmed by sprint runners, cross-country skiers, and ski jumpers, however, they accounted for a small percentage of all respondents, i.e. about 20.5% [18].

A study by Milewska et al. Assessed the use of dietary supplements by a selected group of cyclists. This study showed that 87% of respondents use supplements to their nutrition, including carbohydrate supplements that are used by 39% of cyclists [19].

The consumption of bars has its uses in speed and endurance sports, in which muscle glycogen stores are depleted and blood glucose levels fall. Consumption of bars is intended to quickly replenish energy deficiencies due to their fast-absorbing glucose content. However, according to Kasprzak et al. the use of glucose one hour before exercise is not recommended, due to the possible occurrence of hyperglycemia and a rapid drop in glucose after only 15 minutes of exercise, for which reason the consumption of bars should take place 5-10 minutes before the planned workout [20].

Nutritional support is a very important part of modern sports. A number of studies indicate a widespread belief among physically active people that supplements are necessary to achieve the best possible athletic performance. In a study of the relationship between the sport performed and the belief that energy bars are necessary, as many as 80% of cyclists believe that there is a need for such products in their sport. A study by Krejpcio et al. found that 70% of respondents believe that supplementation is necessary for the training they perform [21].

Conclusions

The results of sensory evaluation of the bars prepared according to the author's recipe for flavor at the medium level and texture, which was rated lower than in the case of compared market products, indicate the need to modify their composition, especially in terms of improving the texture.

Energy bars according to the author's recipe are characterized by higher dietary fiber content, lower energy value, and lower sucrose content.

Carbohydrate supplements are used by respondents, especially if it is justified in the case of practicing endurance and endurance sports characterized by high intensity of training, i.e. cycling and running.

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