

Knowledge and consumption frequency of probiotics and fermented foods in elite volleyball players-A pilot study

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ABSTRACT: Despite growing research on the health benefits of probiotics in athlete populations, there has been little investigation into athletes' consumption of probiotics and fermented foods. Similarly, data is limited about athletes' fermented and probiotic foods consumption. This study aimed to examine the experiences with probiotics, and the frequency of consuming probiotics and fermented foods in a sample of elite Turkish athletes. The secondary aim was to provide data on the existing literature on the dietary intake of the athletes. A total of 30 elite volleyball athletes, 19 male, and 11 female, of a club competing in Turkey's adult men's first league and Turkey's adult women's second league in the pre-season period of 2016 were included in this pilot study. A questionnaire include general characteristics questions, experiences, and thoughts about probiotics, and a fermented food frequency questionnaire was applied face to face. Athletes' nutrient intakes were calculated by dietary records obtained on 3 consecutive days. The energy and macronutrient intakes were calculated via a software program. Athletes' anthropometric measures were determined. A total of 60% reported that they have never heard of the term "probiotic" before. The main reason to use probiotics was "good gastrointestinal health" and the main reason for initially trying probiotics is "positive experiences with others". Athletes who had never taken probiotics would consider using probiotics in the future (73.9%) if they would know what probiotics were. Except for cheese types, fermented foods and beverages consumption was low. Athletes were willing to learn and use probiotics. Investigation of the use of probiotics and consumption of fermented foods will enlighten a better understanding of athletes' actual behavior, and may increase the possible health effects of probiotics.

KEYWORDS: Athletes; sports nutrition; nutritional knowledge; probiotics; fermented foods.

1. INTRODUCTION

Different parts and the gut of the human body contains up to 100 trillion micro-organisms with a thousand different species of known bacteria, so thus the microbiota have more than three million genes (150 times more than human genes) [1]. Each individual's gut microbiota is like an individual identity card [2]. Factors such as diet, stress, physical activity, and exercise affect the microbiota [3,4]. Probiotic supplements and fermented foods have become popular due to their nutraceutical benefits. Probiotics as dietary supplements are increasingly being preferred by athletes to have benefits on athletic performance, upper respiratory tract infections, the immune system, oxidative stress, and gastrointestinal problems [5].

Probiotics are defined as "live microorganisms that, when administered in adequate amounts, confer a health benefit on the host" by the Food and Agriculture Organization of the United Nations and World Health Organization [6]. Probiotics comprise bacterial cultures, mainly *Lactobacillus*, *Bacillus*, and *Bifidobacterium*, and some yeast strains of *Saccharomyces* genera [7]. The term probiotics refer to probiotic drugs (medicinal products – live biotherapeutic products for human use), medical devices, probiotic foods (e.g. foods, food ingredients, and dietary supplements), direct-fed microbials (for animal use), and designer/genetically-modified probiotics. probiotic products are generally marketed as foods or dietary supplements for a healthy population [8,9]. On the other hand, traditional fermented foods consumed in different cultures are different than probiotics. Fermented foods are defined as "foods or beverages produced through controlled microbial growth, and the conversion of food components through enzymatic action" [10]. While probiotics are available in pills and powders etc., fermented foods have historically been in the traditional diets of many countries. Many foods have historically undergone fermentation including meat and fish, dairy, vegetables, soybeans,

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other legumes, cereals, and fruits. Common fermented foods include yogurt, kefir, cheese, sauerkraut, sourdough bread, kimchi, wine, tempeh, kombucha, etc. [11]. Fermented foods contain potentially probiotic microorganisms, such as lactic acid bacteria, and also naturally contain organic acids, ethanol, or antimicrobial compounds [10,11]. The possible health effects of fermented foods are shown as the potential probiotic effect of their microorganisms, the fermentation-derived production of bioactive peptides, biogenic amines, and conversion of phenolic compounds to biologically active compounds, as well as the reduction of anti-nutrients [12].

Recently, there is growing interest in probiotics as nutraceuticals due to their positive effects on athletes' gut health, redox biology, and immunity [13,14]. While most research is aimed at explaining the mechanisms by which probiotics exert their effects, little data exist on the factors that influence an individual's decision to consume probiotics, or what they expect of these products [15]. In this study, we aimed to examine the experiences with probiotics, and the frequency of consuming probiotics and fermented foods in a sample of elite Turkish athletes. Studies on the dietary intake of Turkish elite volleyball players are very limited. The secondary aim was to provide data on the existing literature on the dietary intake of the athletes.

2. RESULTS AND DISCUSSION

2.1. General characteristics

The demographic and general characteristics of 30 athletes are summarized in Table 1. More than half of athletes have Bachelor's degree (56.7%) and live in a big city (63.4%). Athletes have been training for 2 to 20 years with a mean duration of 12.1±4.4 years (Table 1). Athletes' ages ranged from 18 to 31 years with a mean age of 23.6±3.8 years.

Table 1. Demographic and general characteristics of athletes.

Characteristics of total 30 Athletes	n (%)
Age, year (mean ±SD)	23.6±3.8
Sex	
Female	11 (36.7%)
Male	19 (63.3%)
Training duration, year (mean ±SD)	12.1±4.4
Education Level	
High school	12 (40%)
Bachelor's degree	17 (56.7%)
Master's degree	1 (3.3%)
Place of living	
Town	1 (3.3%)
City	10 (33.3%)
Big City	19 (63.4%)

SD: standard deviation

Athletes' mean height and weight were 198±7cm and 89.4±8.7 kg for men and 180±7cm and 64.6±7.5 kg for women. The mean body mass index (BMI) was 21.6±2.1 kg/m² (range 16-26 kg/m²) (Table 2). The majority of athletes' (66.7%) meals are prepared by their families, and only 26.7% of them prepare their meals. The total dietary energy and protein intake of athletes were 28.9±11.2kcal/kg/day and 1.2±0.4g/kg/day, respectively. Energy ratios from macronutrients are seen in Table 2.

Table 2. Anthropometric measurements, and energy and macronutrients intakes of athletes.

Measurements and Dietary Intakes	Mean $\pm$ SD
Height, (cm)	180 $\pm$ 7 (female) 198 $\pm$ 7 (male)
Weight, (kg)	64.6 $\pm$ 7.5 (female) 89.4 $\pm$ 8.7 (male)
BMI (kg/m ²)	21.6 $\pm$ 2.1
Energy (kcal/kg/day)	28.9 $\pm$ 11.2
Protein (g/kg/day)	1.2 $\pm$ 0.4
Carbohydrates % (based on energy)	35.2 $\pm$ 7.7
Protein % (based on energy)	17.5 $\pm$ 4.6
Fat % (based on energy)	47.2 $\pm$ 6.1

SD: standard deviation, BMI: Body Mass Index

Athletes' needs of energy and protein per kilogram body weight per day are 40-70 kcal, and 1.4-1.8 g, respectively [16]. In the present study, we observed that the athletes' energy and protein intakes were below recommendations. Another study with elite female volleyball athletes showed that athletes consumed fewer total kilocalories and carbohydrates with high protein according to recommendations [17]. Similarly, Wierniuk and Włodarek [18] found insufficient energy and carbohydrate intake by young male athletes who were participating in aerobic sports. Studies show that an athlete's diet is frequently unbalanced and insufficient; in terms of protein, carbohydrates [19], vitamins and minerals [20], and energy [21,22].

2.2. Probiotics use and experiences

Probiotics use, knowledge, and preferences about probiotics are summarized in Table 3. A large number of athletes (60%) reported that they have never heard of the term "probiotic" before, and only 13.3% of athletes were familiar or very familiar with the probiotic term. Most of the athletes who had familiarity with probiotics had first heard of them through the internet which is similar to the findings of Mercer et al. [23] and Chin-Lee et al. [15] studies with patients. The second and third source of information about probiotic was obtained from a friend and a doctor, respectively. It is seen that the effect of healthcare professionals on this issue is low, and also pharmacists are not among the answers.

Table 3. Knowledge and experiences of probiotics in the athletes.

Questions	n	%
Familiarity with the word probiotic	30	
Extremely familiar	0	0
Very familiar	3	10.0
Familiar	1	3.3
Somewhat Familiar	8	26.7
Never heard of it before	18	60.0
The use of a probiotic food or supplement to obtain healthful benefits (Except for athletes who have never heard probiotics before)	12	
No	5	41.7
Yes	7	58.3
Source of information on probiotics* (Athletes who had familiarity with probiotics)	12	
Internet	6	50.0

Friends	5	41.7
Doctors	4	33.3
Dietitians	2	16.7
Pharmacists	0	0
When the definition of probiotic is known, the future use of probiotics	23	
(Athletes who had never use probiotics before)		
Yes	17	73.9
No	6	26.1
Concern on probiotics use		
Cost	1	4.3
Side effects	14	60.9
Efficacy	6	26.1
Attitudes of health professionals	1	4.3
Taste	1	4.3
The preferred form of probiotics*	30	
Incorporated into food	14	46.6
Capsule or tablet	4	13.3
Liquid	7	23.3
Powder	5	16.7
The preferred place of purchase*	30	
Pharmacy	9	30.0
Doctor's office	14	46.7
Supermarket	5	16.7
Healthy product stores	2	6.7
Herbalists	0	0
Internet	0	0

* These questions applied after information about probiotics definition to athletes who had never heard of the term before

Studies on the awareness of the word probiotic have been conducted in different populations with different methodologies, and the results are still limited. In a study with patients at community-based health care services in the United States, Chin-Lee et al found that 65.2% of patients were familiar with it [15]. In Brazil, Viana et al. found that 28.57% of consumers failed to express any concept about probiotics [24]. In a study on patients with inflammatory bowel disease, and irritable bowel syndrome, it was observed that patients had varying degrees of familiarity with probiotics, some patients had never heard the term while others had some knowledge of them [23]. In another study with medical science students, it's been found that 51% of students have good knowledge about probiotics, but their awareness about probiotic products is found insufficient. It is seen in the studies that there is a great difference between the results of the studies on the familiarity of the word probiotic or its full definition [25]. In the present study, 60% of athletes reported that they have never heard of it. Considering this high result, athletes need to receive nutrition education about probiotics. Because, previous studies showed that, although they had high healthy eating attitudes the nutritional knowledge of athletes is generally low, and was related to eating behavior. Nutrition education has significantly increased athletes' knowledge [26].

Athletes who had never taken probiotics would consider using probiotics in the future (73.9%) if they would know what probiotics were. For athletes who had never used probiotics before, the most common concern about probiotic use (60.9%) was side effects. Athletes would prefer to use probiotics mostly (46.6%) incorporated into food. Nearly half of athletes would like to buy probiotic products from a doctor's office (46.7%) and the second option was from a pharmacy (30%). They prefer to learn more about probiotics from a

doctor, a dietitians, and a pharmacists, respectively. They didn't choose another option like TV, internet, or a friend as the first three options (Table 4).

Table 4. Learning preferences about probiotics of all the athletes

The preferred learning options about probiotics*	Rank of preference (n=30)				
	1st n (%)	2nd n (%)	3rd n (%)	4th n (%)	5th n (%)
Doctors	26 (86.7)	3 (10)	1 (3.3)	0	0
Dietitians	3 (10)	19 (63.3)	3 (10)	4 (13.3)	1 (3.3)
Pharmacists	1 (3.3)	6 (20)	15 (50)	5 (16.7)	2 (6.7)
Internet, TV.	0	2 (6.7)	4 (13.3)	12 (40)	6 (20)
Family / Friends	0	0	4 (13.3)	4 (13.3)	16 (53.3)

*They were asked to rank from one to five in the preference.

Experiences, and attitudes of probiotics in the athletes who used probiotics are presented in Table 5. Only 7 (23.3%) athletes had used a probiotic food or supplement in the past and mostly “to maintain good gastrointestinal health”, and “to support the immune system”. 42.9 % of them had consumed probiotics as a food product and a capsule/pill/powder, and 71.4% of them did not know which organisms were present in the probiotic. While most of them (85.7%) were not sure whether the supplement had been beneficial or not, the main reason (100%) for initially trying probiotics was “positive experiences with others”. A majority of athletes had not informed their medical doctor (57.1%), and half of them thought that “it was none of my physician’s business”.

Table 5. Experiences and attitudes of probiotics in the athletes who used probiotics

Questions about the use of probiotics	Athletes who used probiotics (n=7)	
	n	%
Use for medical purposes		
To maintain good gastrointestinal health	4	57.1
To support the immune system	3	42.9
Initial purpose to try probiotics		
Positive experiences with others	7	100
The form of probiotics been used		
Food/ As a meal (kefir, yogurt, pickles, etc.)	2	28.6
Supplement	2	28.6
Both	3	42.9
Being aware of what kind of probiotics in the product were exist		
Yes	2	28.6
No	5	71.4
Have probiotics been helpful?		
Yes	1	14.3
No	0	0
Not sure	6	85.7
Sharing information with the doctor on probiotic use		
Not seen a doctor on that moment	3	42.9
Yes	0	0

No	4	57.1
Reasons not to inform doctor		
Forgot to say	2	28.6
I was afraid my doctor would be angry/dissatisfied	0	0
I thought it didn't matter	2	28.6
I thought it was none of my doctor's business.	3	42.8

Despite the health benefits of probiotics on athletes such as reducing exercise-induced stress, improving immunity; reducing the gastrointestinal stress and upper respiratory tract infections, and improving intestinal microbiota and permeability [27], athletes' probiotic intake has not been fully detected. Studies on the assessment of probiotics use reflect more consumers. As a result of a large telephone survey, a New Zealand cohort study, the prevalence of probiotic use was 25.4% of respondents [28]. Similarly, Chin-Lee et al [15] found that 29.9% of patients had used probiotics in the past. In another study on young Canadian athletes around 4% of athletes consumed probiotic supplements regularly, 14-20% occasionally, and 77-87% had never consumed them [29]. The main reason (100%) for initially trying probiotics is only "positive experiences with others" which is similar to the findings by Gerasimidis et al. It's been found in children with inflammatory bowel disease that the main reason was based on a recommendation by a friend [30].

2.3. The frequency of consumption of probiotics and fermented foods

Athletes' fermented foods consumption frequencies are presented in Table 6; 36.6% of athletes consume yogurt daily and 20% of them consume yogurt 3-4 times a week. 50% of athletes never consume kefir and 30% of them never consume probiotic yogurt products. Fresh white cheese's daily consumption frequency was 83.3% as daily. Almost half of the athletes consume old/fermented cheese types daily (46.6%). Half of them rarely or never consume sauerkraut. More than half of athletes never consume beetroot pickle/juice, turnip pickle/juice, vinegar, and boza (a Turkish traditional fermented beverage).

Table 6. Fermented foods consumption frequencies of the athletes.

Fermented Foods	Everyday		3-4 times a week		Once or twice a week		Once or twice a month		Rarely		Never		Total
	n	%	n	%	n	%	n	%	n	%	n	%	
Yogurt	11	36.6	6	20	7	23.3	2	6.7	2	6.7	2	6.7	30
Kefir	1	3.3	3	10	0	0	3	10	8	26.7	15	50	30
Ayran	3	10	11	36.6	10	33.3	2	6.7	2	6.7	2	6.7	30
Probiotic yogurt products	2	6.7	4	13.3	5	16.7	4	13.3	6	20	9	30	30
Fresh Cheese types	25	83.3	2	6.7	1	3.3	0	0	0	0	2	6.7	30
Fermented/Old Cheese types	14	46.7	3	10	4	13.3	1	3.3	5	16.7	3	10	30
Sauerkraut	2	6.7	0	0	7	23.3	6	20	7	23.3	8	26.7	30
Vegetable Pickles	2	6.7	2	6.7	14	46.6	4	13.3	5	16.7	3	10	30
Beetroot pickle/juice	1	3.3	0	0	2	6.7	3	10	5	16.7	19	63.3	30
Turnip pickle/Juice	0	0	0	0	3	10	3	10	7	23.3	17	56.7	30
Vinegar	0	0	1	3.3	4	13.3	0	0	5	16.7	20	66.7	30
Boza*	0	0	0	0	2	6.7	1	3.3	4	13.3	23	76.7	30
Wine	1	3.3	0	0	2	6.7	3	10	9	30	15	50	30
Kumys	0	0	0	0	0	0	0	0	1	3.3	29	96.7	30

* A Turkish traditional fermented beverage

Most probiotics are normally consumed in the form of yogurt, fermented milk, or other fermented foods like sauerkraut and pickles [31]. In the present study, athletes' probiotic food consumption was determined. We found that 36.6% of athletes consumed yogurt daily. Other studies showed that 71% of basketball and volleyball athletes consume milk and dairy products daily [32]; 47% of American football athletes in Polish clubs consume dairy products at least twice a day [33]. Bowman developed a brief probiotic food frequency questionnaire (PRO-Q) to evaluate the intake of probiotic foods among collegiate athletes. The general intake of probiotic/fermented foods in this study was low (0.77 servings/day), also only 17% of athletes reported daily consumption. Yogurt was consumed daily by 11.9% of athletes while conversely 90.5% to 100% consumed kefir and sauerkraut less than once monthly [34]. In the present study, 50% of the athletes rarely or never consumed sauerkraut. In another study with university students, yogurt was the product consumed most frequently by respondents, 3.70% of them reported that they consume the product every day and 27.80% said they consume it at least once a week [35]. In the current study, most of the athletes consume fresh cheese daily. Based on animal studies; cheese containing probiotics [36] and probiotic yogurt [37] may be an applicable alternative to enhance the immune system and could be used to prevent infections, particularly those related to the physical overexertion of athletes. It has been shown that probiotics can improve gut barrier functions [38] and the antioxidant capacity, and decrease inflammatory response in rodents after exhaustive exercise [39].

This study has some limitations such as a small number of athletes and study period. Additionally, the questionnaire being administered face-to-face and dietary records may cause possible social desirability bias. The food consumption of athletes would be different for the season period. The robustness of the questionnaire was not established because the data form used in this study was not valid and reliable. Therefore, the results of the current study can only be generalized for this population during the pre-season period.

3. CONCLUSION

This current study was the first research on athletes' eating behaviors and knowledge about probiotics and fermented foods in Turkey. A majority of athletes don't know about probiotics but they seem to be willing to learn or to know more about probiotics from a health expert as a doctor or a dietitian, which should lead us to a call for action. Despite a growing number of studies on probiotics, there is still little knowledge about athletes' experiences with probiotics which can affect their use. Athletes' poor eating behaviors and knowledge about probiotics support the requirement of nutrition counseling and education to enable athletes to improve their eating habits and health, as well as to optimize their sports training performance. The present study attempted an initial exploration of athletes' attitudes to probiotics, but future research is required to better understand its associated factors.

4. MATERIALS AND METHODS

In this cross-sectional pilot study, a total of 30 elite volleyball athletes of a club competing in Turkey's adult men's first league (19 male) and Turkey's adult women's second league (11 female) in the pre-season period of 2016 were included in this pilot study. All athletes in the club voluntarily participated in the study. A face-to-face questionnaire was administered which collected information on the athlete's demographic characteristics, their knowledge and experiences with probiotics, and the frequency of consumption of 14 fermented food products such as yogurt, kefir, ayran (a traditional Turkish drink containing yogurt, water, and salt), probiotic yogurt products, fresh cheese types, fermented/old cheese types, sauerkraut, vegetable pickles, beetroot pickle/juice, turnip pickle/juice, vinegar, boza (a Turkish traditional fermented grain beverage), wine, kumys. A fermented food frequency questionnaire (Fer-FFQ), which includes 14 fermented food products, was created by researchers, that question consumption frequencies such as every day, 3-4 times a week, one or twice a week, one or twice a month, rarely, and never. Athletes who had familiarity with the probiotic term, and previously used probiotics and athletes who had not used probiotics or never heard of the term answered different questions but they all completed the Fer-FFQ and provided dietary records.

Experiences and attitudes of probiotics in the athletes who used probiotics were evaluated with several questions. The type and benefit of the probiotics, their use for medical purposes, and first purpose in trying probiotics, and the form of probiotics were evaluated. It was questioned whether they informed their doctors about the use of probiotics and the reasons for not informing them. Medical purposes were presented as side effects related to antibiotics (diarrhea, abdominal distension, flatulence, fungal infection), chronic diarrhea, chronic constipation, inflammatory bowel disease, spastic colon syndrome, allergic skin problems (eczema),

preventing the recurrence of vaginal infections, maintaining the health of the digestive system, to support the immune system. Initially, purpose to try probiotics were presented as dissatisfaction with western/classical medicine remedies, protection from the side effects of western/classical medicine drugs, feeling hopeless, feeling safe, having positive experiences with others, and limited other alternatives, to complement other treatments.

Athletes who had familiarity with the term probiotic asked for the source of information about probiotics such as doctors, dietitians/nutritionists, pharmacists, nurses, family, friends, neighbors, brochures/advertisements, internet, television/radio, television/radio advertisements, books, clinical studies, newspapers.

After the definition of probiotics "living organisms that are beneficial for health when consumed" was explained, several questions, which were possible use in the future and concern about probiotics, were asked to the athletes who never use probiotics before. Cost, side effects, efficacy, attitudes of health professionals, and taste were presented as concern options. All the athletes were asked for the place of purchase, the form of probiotics they preferred to use, and their learning preferences about probiotics.

Athletes' nutrient intakes were calculated by dietary records obtained on 3 consecutive days. These records were confirmed by the researchers to prevent any missing or unclear records. The energy and macro/micro nutrients were calculated via a software program the Nutrition Information System (BeBIS) 7.2 [40]. All athletes' anthropometric measures were determined. Height and weight were measured with a stadiometer and an electronic scale by the club doctor, respectively. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters (kg/m^2). The Helsinki protocol was followed throughout the study and the privacy of the athletes was protected.

Statistical analysis was performed with IBM SPSS Statistics for Windows, version 20. Data for continuously measured variables were expressed as mean with standard deviation, and data for categorical items were expressed as numbers (n) and percentages (%).

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