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PLANTS, ALGAE, CYANOBACTERIA AND FUNGI IN DIET OF VEGAN AND VEGETARIAN SPORTSMEN-A SYSTEMATIC REVIEW

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Abstract Vegan and vegetarian diets have become increasingly popular in developed countries. The aim of the research presented here is to review publications referring to the role of plants, algae, bacteria and fungi in the diet of vegan and vegetarian sportsmen published in the period 2000–2021. The review of the literature was based on peer-reviewed original full-text articles and patents using the ISI Web of Science database, as well as the Google Scholar and Google Patents search engines. Factorial combinations of the following keywords were applied: ('plant' or 'alga' or 'fungus' or 'cyanobacteria') and ('athlete' or 'sport') and ('food' or 'nutrition' or 'diet') and ('vegan' or 'vegetarian'). The survey of the literature, carried out according to PRISMA statements, showed that many taxa canbe used in manufacturing products enhancing sport nutrition, athletic performance, mental alertness, physical health, preventing disorders and controlling body weight. Numerous authors found that the ingestion of plant constituents such as caffeine and proteins enhances muscle growth and recovery. Other investigations indicated the occurrence of beneficial effects, as well as imperfections, ofnon-animal diets. The performed investigations documented that acceptance of vegan and vegetarian diets flows from religious and ethical beliefs, as well as the advantages of sustainable eating practices.

Key words athlete, health, non-animal diet, nutrition, sport

Introduction

The increasingly popular animal-avoiding diets in developed countriesare classified into two main categories, vegetarian and vegan, with each category further subdivided by the inclusion or exclusion of processed or naturally occurring products. Vegetarian or vegan diets may be practised for a variety of reasons, including health, cultural, philosophical, religious, and ecological beliefs, or simply because of taste preferences (Phillips, 2005; McGirr, McEvoy, Woodside, 2017; Parker, Vadiveloo, 2019). Numerous nutritionists (Craig, Mangels, 2009; Melina, Craig, Levin, 2016; Agnoli et al., 2017) have highlighted that well-planned vegetarian diets that include a wide variety of plant foods and a reliable source of vitamin B12 provide adequate nutrient intake. The beneficial effects of vegetarian and vegan diets on health outcomes have been reported by numerous authors (Dinu, Abbate, Gensini, Casini, Sofi, 2017 and literature cited here).

According to other authors (e.g. Nieman, 1999; Trapp, Knez, Sinclair, 2010), athletes who consume diets rich in fruit, vegetables and whole grains receive high amounts of antioxidant nutrients that help reduce the oxidative stress associated with heavy exertion, whereas for athletes who are mostoften concerned with performance, vegetarian diets also provide long-term health benefits and a reduction in risk of chronic disease. Moreover, well-designed plant-based diets provide adequate nutrient intakes for all stages of the life cycle and can also be useful in the the rapeutic management of some chronic diseases such as heart disease, hypertension, type 2 diabetes, obesity and some cancers. Low intake of saturated fat and high intakes of vegetables, fruits, whole grains, legumes, soy products, nuts, and seeds (all rich in fibre and phytochemicals) are characteristics of vegetarian and vegan diets that produce lower total and low-density lipoprotein cholesterol levels and better serum glucose control. Furthermore, a plant-based diet could make more conservative use of natural resources and cause less environmental degradation (Meyer, Reguant-Closa, 2017).

To date, several authors have reviewed investigations focusing on the benefits and disadvantages of vegan and vegetarian diet for sportspeople (Forbes-Ewan, 2002; Holmes, Willoughby, 2018; Lis, Kings, Larson-Meyer, 2019, D'Angelo, Cusano, 2020, Maziarz, Chojęta, Zygmunt, Wróblewski, Zimna, 2020; Wirnitzer, 2020; Devrim-Lanpir, Hill, Knechtle, 2021), the effect of plant-based diets on endurance performance, particularly inflammation, oxidative stress and immune responses (Pilis, Stec, Zych, Pilis, 2014; Craddock, Probst, 2015), as well as physical health, environmental sustainability, and exercise performance capacity (Lynch, Johnston, Wharton, 2018). Numerous researchers have focused on general nutritional considerations for athletes and exercisers (Grandjean, 1987; Venderley, Campbell, 2006; Laquale, 2006; Nieman, 1999; Barr, Rideout, 2004; Fuhrman, Ferreri, 2010; Rogerson, 2017; Larson-Meyer, 2018; Carlson et al., 2019; Heller, 2019; Vitale, Hueglin, 2021), including special ones for adolescent girls and young women (Schroeder, Sonneville, 2015). Others researchers concentrated on dietetic advice directed particularly for dancers (Brown, 2018), artistic gymnasts (Jakše, Jakše, 2018) and CrossFit athletes (Carbone, Candela, Gumina, 2020). Schoenfeld (2020) discussed the vegan diet as it pertains to the female athlete. Other authors reviewed the use of nutritional supplements (Kaviani, Shaw, Chilibeck, 2020) and proteins (Bătrînu, Tero-Vescan, Miklos, 2020) by vegetarian athletes.

Despite the growing number of publications summarising the effects of vegetarian and vegan diets on the health and performance of sportspersons, the current state of knowledge is still insufficient. As such, the presented studies were undertaken and their main objectives were to learn: (i) which taxa of plants, algae, cyanobacteria and fungi are used for the production of nutritional products for athletes; (ii) which organs of the aforementioned organisms are applied; (iii) what are the effects of particular constituentson athletes' health and performance; (iv) what are the advantages and disadvantages of a vegetarian/vegan diet (especially in comparison to other dietary regimens); and (v) what are the reasons for practising non-animal diets by athletes.

Material and methods

For this survey, a systematic approach for synthesising information through a dedicated step-wise process for selecting available peer-reviewed literature sources was applied. The author searched for peer-reviewed original full-text articles and patents regarding the application of plants in vegetarian and vegan diets using ISI Web of Science-indexed publications. This search engine was selected as it provides a comprehensive all-encompassing database for various interdisciplinary domains. The review focused on literature records published over the time interval from 2000 to 2021. Moreover, publications were searched by browsing the Google Scholar and Google Patents internet search engines. The author used factorial combinations of the following keywords in the searches: ('plant' or 'alga' or 'fungus' or 'cyanobacteria') and ('athlete' or 'sport') and ('food' or 'nutrition' or 'diet') and ('vegan' or 'vegetarian'). The selection terms were examined from the title, abstract and keywords of the articles. The literature

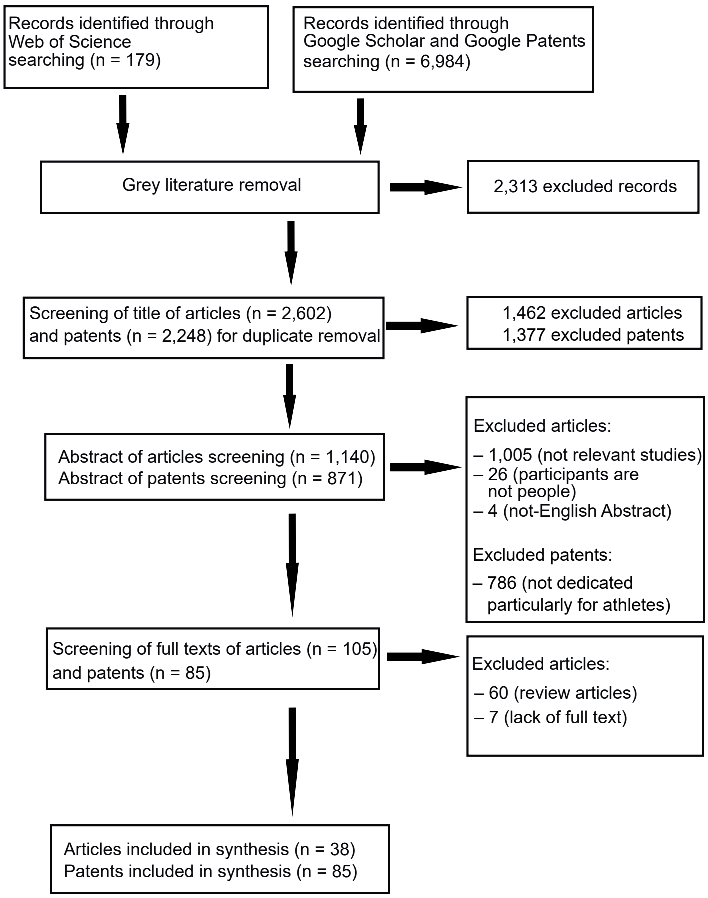

Figure 1. The procedure of literature search according Moher, Liberati, Tetzlaff, Altman (2009)

search was conducted from 20 March to 1 July 2021. The results included 179 hits from the ISI Web of Science, 4,740 from Google Scholar, and 2,244 from Google Patents. After the manual removal of grey literature (blog posts, letters, manuals, guides, bulletins, newsletters, editorials, commentaries, theses, dissertations, reports, conference proceedings, and meeting notes) from the lists of searches, the patents and peer-reviewed articles were selected. Following the removal of duplicates (publications indexed in at least two databases), the abstracts of patents and articles were screened for relevance and eligibility. The only inclusion criterion for patents was their usefulness for sport practitioners. The exclusion criteria for patents were: (i) patents irrelevant to the main subject; (ii) the abstract was not written in English. The inclusion criteria for articles were as follows: (i) investigations are relevant to the main subject of presented review; (ii) participants are people (clinical trials); (iii) no limits in age, weight, sex, nationality and number of participants; (iv) no limits in geographical location, or time period of investigations; and (v) the abstract was written in English. The exclusion criteria for articles were as follows: (i) studies irrelevant to the main subject; (ii) investigations conducted on non-human species; (iii) repetitive publications (different parts of a single study were presented in two or more papers or studies based on a population that was part of an earlier publication); and (iv) the Abstract was not written in English. Finally, a full-text screening was performed. The only inclusion criterion for patents was their usefulness for sport practitioners. The inclusion criteria for articles were as follows: (i) observational, descriptive studies (case report/case series); (ii) observational, analytical studies (case–control studies, cross-sectional studies, cohort studies); and (iii) experimental studies (randomised controlled trials). The exclusion criteria for articles were as follows: (i) meta-analyses; (ii) systematic reviews; (iii) lack of full text; and (iv) lack of full text in English. A final total of 85 patents and 38 articles were selected to be reviewed. A chart detailing the search results is presented in Figure 1.

Results

The survey of patents/ inventions

The performed survey of literature showed that, altogether, 2 species of cyanobacteria, 6 species of fungi, 13 taxa of algae and 124 taxa of plants were used in the production of nutritional products for vegan and vegetarian athletes. The review of publications proved that the plants represented trees (20 species), shrubs (17), shrubs or trees (12), and herbaceous plants (75). The majority of herbaceous plants belonged to short lasting plants: annuals (37), annuals or biennials (2), and biennials (3). Alower number of species represented plants lasting at least two years (1) and perennials (32). In the case of cyanobacteria and algae, the whole organisms of individuals were mostly applied; in the case of fungi, the fruiting bodies were used; while in the case of herbaceous plants, awide spectrum of organs was applied from roots and tubers, toleaves, and to fruits and seeds. The aforementioned organs were used in the production of food ingredients (Table 1) and nutritional products (Table 2). Numerous authors invented nutritive compositions enhancing endurance (Table 3), improving mental alertness (Table 4), maintaining physical health and preventing disorders (Table 5), as well as controling body weight (Table 6).

Table 1. A review of patented nutritional products based on plant constituents used for products devoted for sportspeople on vegetarian or vegan diets in alphabetical order

Inventor(s)	Year	Patent/articletitle	Patent number or patent source	The raw material	Taxa
1	2	3	4	5	6
J.C. Bohlscheid, K.M. Fletcher, L.M. Huffman	2018	Potato protein powders	WO2018183770A1	Tubers	Potato
C.T. Cordle, S.T. Lubbers, L.W. Williams, J.H. Baxter, G. Duska-McEwan	2015	Nutritional products having improved organoleptic properties	CN103153095B	Seeds	Pea
M.L.F. Giuseppin, C. Van Der Sluis, M.Ch. Laus	2008	Native potato protein isolates	CA2669096A1	Tubers	Potato
N.T. Jakel, D. Kotowski, J. Ingvalson, F. Amore, M.J. Beaver, E.J. Fox, A. Patist, M.J. Tupy, J.F. Ulrich	2003	Corn oil processing and products comprising corn oil and corn meal obtained from corn	WO2003016441A1	Seeds	Corn
D. Janow	2014	Rice protein supplement and methods of use thereof	US20140205710A1	Seeds	Rice

1	2	3	4	5	6
L. Kizer, N. Renninger, A. Stiles	2017	Product analogs or components of such analogs and processes for making same	WO2017120597A1	Seeds	Pea, soy, almond, white bean
F.C. Lau, B.P. Daggy, E.P. Fakoukakis	2017	Composition comprising sacha inchi protein in combination with other plant proteins	WO2017027599A1	Seeds	Pea, soy, rice
				Tubers	Potato
T. Paeschke, A. Kozman, T. Rivera, B. Hitchcock	2012	Fiber obtained from fruit or vegetable byproducts	WO2012074959A1	Fruit peel	E.g. orange, grapefruit, lemon, lime
L.A. Scanlin, M.B. Stone, C. Burnett	2010	Quinoa protein concentrate, production and functionality	US20100184963A1	Seeds	Quinoa

Table 2. The review of nutritional supplements devoted for sportspeople on vegetarian or vegan diets in alphabetical order

Inventor(s)	Year	Patent/articletitle	Patent number or patent source	The raw material	Taxa
1	2	3	4	5	6
M. Barata, T.M. Guilleman, E. Moretti, E. Müller, M. Delebarre	2017	Nutritional formulations comprising a pea protein isolate	WO2017129921A1	Seeds	Pea
A.P. Biescas, J.A.T. Mari, P.T. Riera, A.A. Pons, N.C. Porcel, A.P. Florit	2009	Isotonic Energy Drink	US20090246323A1	Seeds	Almond
				Leaves	Tea
B. Boursier, E. Moretti, G. Ribadeau-Dumas, S. Belaid, A. Riaublanc, J. Gueguen, A. Lepoudere, J-J. Snappe, I. Colin	2017	Assembly of at least one vegetable protein and at least one dairy protein	EP2897474B1	Seeds	E.g. soy, pea, bean
A. Budemann, M. Veen	2016	Food composition containing amino acids and cocoa	US20160000133A1	Seeds	Soy, pea, lentil, bean, cocoa
W. Cain, S.M. Milazzo	2014	Nutraceutical formulation	US20140234515A1	Fruit	Coconut, goji, raspberry
				Seeds	Flax
				Tubers	Sweet potato
R.K. Dhillon-Gill	2010	Nutritional suplement	US20100029581A1	Seeds	Flax, chick pea, brown rice, wheat
J.L. Ho, L. Canzhen	2012	Tiger nut yogurt and preparation method thereof	CN102550686A	Tubers	Tiger nut
L. Hongtao	2005	Multiple element nutritive powder	CN1194633C	Seeds	E.g. soy, lotus, sesame, bean, rice, gorgon fruit
Z. Jicheng, L. Xianglin, Z. Jinming, Q. Yuhua, W. Lan, S. Yujie	2015a	Solid (functional) beverage synthesized from hibiscus esculentus, fungi and alga and preparation method thereof	CN104473286A	Fruits	Okra
				Fruiting body	Scarlet Caterpillar club, lion's mane mushroom, poria
				Whole organism	Spirulina maxima
Z. Jicheng, L. Xianglin, Z. Jinming, Q. Yuhua, W. Lan, S. Yujie	2015b	A method of preparing functional chocolate by an okra-fungus-algae plant composition	CN104472816A	Fruits	Okra
				Seeds	Soy
				Fruiting body	Scarlet Caterpillar club, lion's mane mushroom, poria
				Whole organism	Spirulina maxima
J. Lis, P. Marquilly, S. Lagache, L. Retourne	2015	Novel non-allergenic snacks containing vegetable proteins	CA2929948A1	Seeds	Pea, greenalgae

1	2	3	4	5	6
M-L. Mateus, M.G. Roy, Y.M. Thonney	2014	Bite-size nutritional products having a filling and methods for using same	US20140120208A1	Seeds	Peanut
				Fruits	e.g. grape, apple, apricot, banana, vanilla
				Leaves	Peppermint
R.A. Miller, T.B. Shelton	2016	Nutritional or dietary supplements containing fatty acids and nitrite	US20160081962A1	Seeds	e.g. grape, flax, lingoberry, canola, poppy
				Root	Beetroot
L.J. Minus	2012	Nutritional beverage formulation	US20120093981A1	Seeds	Oat, cacao, nutmeg
				Fruits	Banana
W. Qingge	2015	Nutritious porridge with black soybeans and pumpkin seeds and manufacturing method thereof	CN104256340A	Seeds	e.g. soy, pumpkin, rice, Job's tears, peanut
A. Schmidbauer, Ch. Leisser	2011	Iron-complexes extracted from curry leaves and their use	EP2298330A1	Leaves	Curry tree
L. Shaowei, H. Chenkang, K. Lina	2014	Puffed grain energy bar	CN103783121A	Seeds	Corn, soy, rice, buckwheat
J. Szilbereky, A. Jednákovits, A. Salgó, G. Barla Szabó, L. Szabados	2014	A novel raw material for functional foods and a process for the preparation thereof	WO2014060784A2	Seeds	Soy, rice, maize, oat, wheat, chickpea
S. Turner, K. Laporte, S. Al-Murrani, L. Hayward	2010	Controlled release food formulations	WO2010056957A1	Seeds	Flax, walnut, common wheat, rapeseed
R.S. Wilkes	2012	Omega-3 enriched cereal, granola, and snack bars	EP2429318A1	Seeds	e.g. soy, corn, canola, sunflower, millet, kamut
				Fruits	Raspberry, cherry
D. Venturi	2004	Whole meal replacer	WO2004017764A1	Fruits	Rose, apple
				Seeds	Pea
A. Zoia, M.M. Bargardi	2007	Vegetable origin food rich in proteins and nutritious	WO2007013109A1	Seeds	e.g. chick peas, almond, rice

Table 3. The review of nutritive products improving physical performance devoted for sportspeople on vegetarian or vegan diets in alphabetical order

Inventor(s)	Year	Patent/articletitle	Patent number or patent source	The raw material	Taxa
1	2	3	4	5	6
A. Bast, G.R.M.M. Haenen, L.C.R. Van Der Heyden, S.J. Rietjens	2009	Olive extracts for promoting muscle health	WO2008040550A2	Fruits, leaves	Olive
S. Bell, R. Forse, B. Bistrian	2001	Dietary supplement for individuals under stress	US20010022980A1	Seeds	e.g. walnut, peanut, cashew, hazel, flax, soy
W.H. Chou, V. Chou	2011	Herbal compositions and methods for enhancing vital energy and athletic performance	US7906159B2	Leaves	Maidenhair tree
				Roots	Common golden root
J. Cox	2014	Chocolate mass	EP2590514B1	Seeds	Cacao, corn, rice, sorghum, flax, pomegranate
B. Depta	2017	Composition containing aronia berry extract, red spinach extract and beetroot extract	US20170112886A1	Fruits	Aronia
				Roots	Red beet
				Leaves	Red spinach

1	2	3	4	5	6
J. Deshpande, K. Ghanam, V. Srivastava	2016	Macroalgae compositions, processes for preparation thereof, and uses in sports nutrition	US20160287646A1	Leaves	Brown algae e.g. bladder wrack, oarweed, egg wrack
S.E. Durkee, G. Dente	2008	Method and composition for increasing Erythropoietin	US20080241076A1	Roots	Dong quai
				Leaves	Duckweed
R.M. Ferrante, Ch.K. Cunningham	2015	Performance enhancing composition and method of delivering nutrients	US8999424B2	Fruits	E.g. pomegrate, goji berry, blueberry
				Roots	Carrot, beet
C. Germano	2008	Nutritional formula for recovery of athletes	US20080119386A1	Fruits	Blueberry, sour cherry, strawberry
				Seeds	Grape, raspberry
C.W. Hastings, D.J. Barnes, C.A. Daley	2012	Performance-enhancing dietary suplement	US8168241B2	Seeds	Soy, grape, black pepper
M.S. Hausman	2014	A nutritional approach to improving athletic performance and reducing injury with L-ergothioneine and/or vitamin D2	WO2014004647A1	Organism tissue	Mushroom, King trumpet mushroom
S.O. Hill, J.S. Minatelli, R.S. Moerck, U.E. Nguyen	2011	Chia seed composition	DE112009000124T5	Seeds	Chia
K. Khalil, O. Said	2008	Herbal energy-enhancing formulation	WO2008152624A2	Roots	Common chicory
				Leaves	Rocket
D.O. Lukaczer, G.K. Darland, D.J. Liska, T.A. Irving, J.S. Bland	2002	Dietary supplements for treating fatigue-related syndromes	US6352712B1	Leaves	Rosemary
				Root	Ginger
				Rhizome	Curcumin
J.A. Minatelli, W.S. Hill, R. Moerck, U. Nguyen	2009	Chia seed composition	US20090181127A1	Seeds	Chia
J.D. Moore, T.R. Hampton, R. Harrell	2015	Dietary supplements for promotion of growth, repair, and maintenance of bones and joints	US8968791B2	Seeds	e.g. apricot, avocado, blackcurrant, borage, coriander, cotton, kapok, meadowfoam, perilla, poppy, pumpkin
				Whole organism	Algae from genus: Eugena, Botryococcus, Dunaliella, Isochrysis, Nannochloropsis, Neochloris, Phaeodactylum, Pleurochrysis, Prymnesium, Scenedesmus, Spirulina
N. O'Kennedy	2016	Compositions	US20160375080A1	Fruits	Tomato
				Seeds	Groudnut, oat, common wheat
				Roots	Swiss chard
R. Petralia	2012	Nutraceutical beverage	US20120213756A1	Leaves	True aloe
D. Phillips, D. Phillips	2013	Caffeinated creamer	US20130129866A1	Seeds	Coffee
				Leaves	Tea, yerba mate, guayusa, yaupon holly
				Fruit	Guarana
Ch. Roumayeh, S. Bellestri, J.Ch. Jerebko	2015	Nutritional compositions and methods	US20150099032A1	Roots	e.g. Asian ginseng, cadonipsis, licorice
				Fruits	e.g. chestnut rose
N. Silver, M. Hamill, P. Samayoa, J. Hou, L. Hamm, D. Berry	2014	Nutritive polypeptides, formulations and methods for treating disease and improving muscle health and maintenance	WO2014134225A2	Fruits	e.g. apple, peach, pear, plum
				Seeds	Corn, anise
				Leaves	e.g. Peppermint
				Tubers	Potato
				Fruits	Red date, hawthorn
				Rhizomes	Chinese yam

1	2	3	4	5	6
B.D. Tuttle	2002	Dietary supplement for increasing energy, strength, and immune function	US6465018B1	Roots	Asian ginseng, American ginseng,Mongolian milkvetch
H-P. Wild	2016	Compositions for use in food products	WO2016150573A1	Fruits	Citrus, raspberry, blueberry
M. Veen, A. Budemann	2014	Food composition containing amino acids and cocoa	US20140154358A1	Seeds	Cacao, pea, bean, lentil
R. Xiu	2002	Rhodiola and used thereof	US6399116B1	Root	Golden root

Table 4. The review of nutritive products improving mental alertness suitable for sportspeople on vegetarian or vegan diets in alphabetical order

Inventor(s)	Year	Patent/articletitle	Patent number or patent source	The raw material	Taxa
S. Cheyene	2014	Health supplement using guarana extract	US8877258B1	Leaves	Green tea, peppermint, tulsi
				Fruits	Guarana
R.F., Gerardus, J. King, S. Lester	2003	Alertness bar	CA2480100A1	Seeds	e.g. soy, sesame, safflower, flaxseed
T. Stutzman	2017	Sweet tart energy tablet	US9549563B2	Fruits	e.g. orange, strawberry, black cherry, blue raspberry
K. Tao, L. Guanghua	2017	Sweet potato biscuit and preparation method thereof	CN104799317B	Tubers	Sweet potato
				Seeds	Rice
				Root	Kudzu vine, carrot
				Fruits	E.g.medlar

Table 5. The review of nutritive products improving physical health and preventing disorders suitable for sportspeople on vegetarian or vegan diets in alphabetical order

Inventor(s)	Year	Patent/articletitle	Patent number or patent source	The raw material	Taxa
1	2	3	4	5	6
D. Andrews	2006	Nutraceutical Moringa composition	US20060222682A1	Seeds, fruits, leaves	Horseradish tree
J. Ansell, P. Blatchford	2017	Gold kiwifruit compositions and methods of preparation and use therefor	US20170326190A1	Fruit	Kiwifruit
S. Bhardwaj, S. Saraswat	2019	Product development, nutrient and sensory analysis of sports drink based on chia seeds (Salvia hispanica L.)	International Journal of Physiology, Nutrition and Physical Education	Seeds	Chia
Z. Chunshan	2013	Nutrient eight-treasure soup formula and preparation process thereof	CN101797049B	Roots	Carrot, white turnip
				Leaves	White turnip
				Seeds	Barley
				Fruiting body	Wood ear mushroom
A. Jeukendrup, T. Stellingwerff, E. Zaltas	2009	Carbohydrate bar	EP2098126A1	Seeds	Pea, soy, rice,peanut
				Fruits	Vanilla

1	2	3	4	5	6
N.C. Loizou	2009	Health suplement	US20090110674A1	Seeds	e.g. pumpkin, guarana, grape, horse chestnut
				Leaves	e.g. acacia
				Roots	e.g. maca, nettle
M. Robertson	2006	Universal protein formulation meeting multiple dietary needs for optimal health and enhancing the human immune system	US20060280840A1	Seeds	Soy, quinoa, amaranth, millet, rice, safflower
W. Songyi	2015	Plant health solid drink and preparation method thereof	CN104323391A	Seeds	Tibetan goji, wheat, soy
				Fruits	Red date, hawthorn
				Rhizomes	Chinese yam
B.R. Vescovi	2016	Methods and formulations for enhancing hydration	US20160000131A1	Seeds	e.g. flax, chia
				Roots	Konjac, liquorice
				Bark	Slippery elm
				Leaves	e.g. aloe vera
M.J. Vadakkemuri, P.T. Kochery, P.T.J. Kocherry	2016	Optimized nutrient food	WO2016035095A1	Seeds	e.g. sunflower, sesame, soy, flax, fenugreek, cress

Table 6. The review of nutritive products contributing to weight loss suitable for sportspeople on vegetarian or vegan diets in alphabetical order

Inventor(s)	Year	Patent/articletitle	Patent number or patent source	The raw material	Taxa
1	2	3	4	5	6
G. Brooks, S. Franklin, J. Avila, S.M. Decker, E. Baliu, W. Rakitsky, J. Piechocki, D. Zdanis, L.M. Norris	2010a	Methods of inducing satiety	US20100303961A1	Leaves	Purple layer, dulse, sea lettuce
				Organism tissue	Spirulina, Green algae
G. Brooks, S. Franklin, J. Avila, S.M. Decker, E. Baliu, W. Rakitsky, J. Piechocki, D. Zdanis, L.M. Norris	2010b	Reduced-fat foods containing high-lipid microalgae with improved sensory properties	US20100297331A1	Organism tissue	Green algae
G. Brooks, S. Franklin, J. Avila, S.M. Decker, E. Baliu, W. Rakitsky, J. Piechocki, D. Zdanis, L.M. Norris	2012	Novel microalgal food compositions	US20120128851A1	Organism tissue	Green algae
G. Brooks, S. Franklin, J. Avila, S.M. Decker, E. Baliu, W. Rakitsky, J. Piechocki, D. Zdanis, L.M. Norris	2015	Food compositions of microalgal biomass	CN102271525B	Whole organism	Green algae
V.S.P. Chaturvedula, M.P. May, J.A. May, J.E. Zamora	2015	Compositions and methods for the solubilization of stevia glycosides	WO2015127297A1	Leaves	Candy leaf
G. Chunhu	2010	Coffee with weight reducing and antifatigue functions	CN101861903A	Seeds	Coffee, soy
				Leaves	Tea
				Tubers	Jerusalem artichoke

1	2	3	4	5	6
I. Daikeler, M. Wilson, M.L.N. Alamdari	2015	Dietary intervention with reduced daily caloric intake	US20150342237A1	Roots	e.g. maca, milkvetch
				Rhizomes	e.g. Yacon
				Leaves	e.g. horseradisch, green tea
				Fruits	e.g. goji,bilberry
				Seeds	e.g. flax, grape
J. Deaton, H.G. Dawson	2014	Proteolytic compositions for rapidly and extensively degrading protein supplements	WO2014130007A1	Stems	Pineapple
Q. Jian, Z. Junjie	2014	Preparation method of fat-fighting low-calorie full-nutrition meal replacement preparation	CN103494213A	Seeds	Rice, sunflower, maize
Z. Junling	2014	Health-maintaining and weight-reducing type blending oil	CN103651949A	Seeds	e.g. rice, sunflower, rapeseed, soy, sesame
D. Narasimhan, S. Narasimhan	2016	Hunger minimizing juice fasting system	US20160100615A1	Fruits	e.g. apple, orange, watermelon, grape
				Roots	E.g. carrot, beetroot
P. Oddenino	2014	Food composition with thermogenic function	EP2064961A1	Seeds	Coffee
H.W. Selby	2014	Cholesterol-reducing diet	US8821947B2	Fruits	Cocoa
				Seeds	Olive, canola, flax, walnut
T. Tao, L. Ting	2017	Quinoa nutritive meal replacement powder	CN106306993A	Seeds	Quinoa, soy, rice
N. Xuemei	2013	Weight-reducingand meal replacement protein type solid beverage	CN102687750B	Seeds	Soy

The survey of investigations on plant constituents suitable for sportspersons

The effect of ingestion of plant constituents

Senger, Bohlinger, Esgaib, Hernández-Cubero, Montes, Becker (2017) found, that the oil- and protein-rich kernels of the subtropical plant chuta (*Jatropha curcas* L.) can be exploited as a snack and as an ingredient for foodstuffs which can complement the diets of vegetarians and vegans, professional athletes, or persons who have to restrict their consumption of carbohydrates for medical reasons. Other authors confirmed the beneficial effects of caffeine (Vanata, Mazzino, Bergosh, Graham 2014), as well as soy, whey and pea proteins (Tang, Moore, Kujbida, Tarnopolsky, Phillips, 2009; Banaszak et al., 2019; Lynch et al., 2020) on muscle growth and athletic performance. Moreover, Naclerio, Seijo, Earnest, Puente-Fernández, Larumbe-Zabala (2020) evidenced that a post-workout vegan-protein multi-ingredient admixture speeds upthe recovery of muscular function in young males. At the same time, other authors (Earnest et al., 2004; Gallien, Bellar, Davis, 2017) found the lack of performance benefits of selected vegan products in cyclists (Table 7).

Table 7. A review of original articles devoted to the effects of plant constituents on health and athletic performance of sportspeople in alphabetical order

References	Physicalactivity	Treatement	Results
Banaszek et al. (2019)	High-intensity functional training	Consumption of 24 grams of whey vs 24 grams of pea protein	Increase instrength for maximum back squat and deadlift in both groups. No differences of body composition and muscle thickness
Earnest et al. (2004)	Cycling	14-days supplementation period of adapotogen formula (*Cordyceps sinensis* mycellium and *Rhodiola* extract) or placebo (methycellulose)	No difference between groups for any peak exercise variables including peak VO_2, time to exhaustion and peak heart rate (HR)
Gallien et al. (2017)	Cycling	Consumption 30 minutes prior to trial of vegan pre-workout supplement vs. zero-calorie placebo supplement	No difference in cycling performance between groups
Lynch et al. (2020)	Recreative training	Consumption of 19 grams of whey protein isolate vs 26 grams of soy protein isolate	Consumption of whey and soy protein increases total body mass, lean body mass, peak torque of leg extensors and flexors
Naclerio et al. (2020)	Resistance training	Consumption 10 min. after workout completion of workout protein-vegan multi-ingredient admixtures vs. maltodextrin admixtures	Lower contraction velocity of vastus medialis after maltodextrin admixture. Better vertical jump and squat performance after protein-vegan admixture
Tang et al. (2009)	Unilateral leg resistance exercise	Consumption of a drink containing an equivalent content of essential amino acids (10 g) as either whey hydrolysate, micellar casein, or soy protein isolate	Higher muscle protein synthesis at rest and after excercise after ingestion of whey and soy than casein
Vanata et al. (2014)	The sprint-distance swimming	Consumption 3 milligrams of caffeine per kilogram of body weight	Improvement of swim times. Greater excretion of urinary caffeine in females

The effect of vegetarian/vegan diets on health and athletic performance

Nebl, Schuchardt, Wasserfurth, Haufe, Eigendorf, Tegtbur, Hahn (2019a), Nebl, Haufe, Eigendorf, Wasserfurth, Tegtbur, Hahn (2019b), Nebl, Drabert, Haufe, Wasserfurth, Eigendorf, Tegtbur, Hahn, Tsikas (2019c), Nebl, Schuchardt, Ströhle, Wasserfurth, Haufe, Eigendorf, Tegtbur, Hahn (2019d), as well as Woodbridge, Konstantaki, Horgan (2020) suggested that a well-planned health-conscious lacto-ovovegetarian and vegan diet, including supplements,can meet the athlete's nutritional requirements. Numerous researchers claimed that plant-based diets are beneficial for muscle strength and endurance in women and men in different age groups (Haub, Wells, Campbell, 2005; Boutros, Landry-Duval, Garzon, Karelis, 2020; Hevia-Larraín et al., 2021). At the same time, Wirnitzer (2010) evidenced that athletes involved in heavy endurance exercise should ingest a higher amount of energy from carbohydrates to maximise muscle glycogen synthesis. Other authors argued that plant-based diets show a beneficial influence on heart morphology (Król et al., 2020), a reduction of risk of heart diseases (Chang et al., 2020; Śliż et al., 2021), as well as the improvement of cardiorespiratory fitness (Lynch, Wharton, Johnston, 2016). Further positive effects, such as the increase of blood testosterone level in men (Ciara, 2019) and body mass loss (Ciuris, Lynch, Wharton, Johnston, 2019; Wirnitzer et al., 2019; Hernández-Martínez, Fernández-Rodríguez, Soriano, Martínez-San, 2020; Davey, Malone, Egan 2021), were evidenced at the same time. In addition, Yadav, Mukhopadhyay, Yadav (2020) proved that lacto-vegetarians reported greater exercise duration and physical fitness than non-vegetarians. At the same time, it is worth mentioning that Veleba, Matoulek, Hill, Pelikanova, Kahleova (2016) observed a slight improvement in physical fitness after a training programme with a vegetarian diet as compared with a conventional hypocaloric diet in patients with type 2 diabetes.

On the other hand, some researchers pointed out the imperfections of a vegetarian and vegan diet, such as the rise of oxygen consumption during submaximal cycling (Hietavala, Puurtinen, Kainulainen, Mero, 2012), the increase of post-exercise oxidative stress (Nebl et al., 2019c), the low level of selected microelements and vitamins (Gröber, 2020), as well as the risk of osteoporosis and anaemia (Klimatskaya, Zaitseva, 2015). Khanna, Lal, Kommi, Chakraborty (2006) found that intakeof some nutrients, haemoglobin level, endurance time, and recovery were better in non-vegetarians than in lacto- or ovo-lacto- female athlete vegetarians. Gibson-Smith, Storey, Ranchordas (2020) proved that serum ferritin level is significantly lower in vegan/vegetarian than in omnivore climbers, while Potthast, Nebl, Wasserfurth, Haufe, Eigendorf, Hahn, Das (2020) observed that enzymatic activities of essential regulators of cellular energy metabolism increase during exercise in omnivores and lacto-ovo vegetarian runners, and decreases in vegans (Table 8).

Table 8. A review of original articles devoted to the effects of plant-based diets on health and athletic performance of sportspeople in alphabetical order

References	Sport discypline	Gender	Age (years)	Diet of participants	Main components of vegan/vegetarian diet	Results of plant-based diet
1	2	3	4	5	6	7
Boutros et al. (2020)	Recreative training	W	25.6 ±4.1	Vegan diet vs. omnivorous diet	.	↑ of estimated VO_2 max ↑ of submaximal endurance time to exhaustion
Chang et al. (2020)	Excercise	M, W	30–70	Vegetarian vs former vegetarian vs non vegetarian	.	↓ of high-density lipoprotein cholesterol (HDL-C)
Ciara (2019)	Rereational weight training	M	20–70	Omnivorous vs vegetarian diet	.	↑ of marginal mean testosterone
Ciuris et al. (2019)	Endurance sports (triatletlon, runnig, cycling)	M, W		Omnivorous vs vegetarian diet	Whey, soy, corn, bean, peas, peanuts, potato, sweet potato, rice, sunflower	↓ of body weight and body mass index
Davey et al. (2021)	Gaelic football	M	25	Omnivorous vs vegan diet	Banana, peanuts, rice, quinoa, apple, chickpea	↓ of lean body mass, Ø in fat body mass, Ø in running performance
Gibson-Smith et al. (2020)	Climbing	M, W	30.3 ±6.7	Omnivorous vs vegetarian/ vegan diet	.	↓ of mean serum ferritin level ↓ of protein intake level
Gröber (2020)	Swimming	W	29	Vegetarian	.	↓ of iron, selenium, vitamin D and vitamin B12
Haub et al. (2005)	Resistive exercise training	M	65 ±5	Plant-based food vs meat -based food	Soy	↑ of overall muscle strength and muscle power ↓ of total cholesterol ↓ of low-density lipoprotein cholesterol ↓ of high-density lipoprotein cholesterol
Hernández-Martínez et al. (2020)	Powerlifting	M		Vegan diet	Chickpea, soy, carrot, rice, pepper, lentil, bean, tomato, banana	↓ of body mass ↓ of fat mass ↑ of fat-free mass
Hevia-Larraín et al. (2021)	Resistance training	M	26	Omnivorous vs vegan diet	Soy	↑ of leg lean mass ↑ of rectus femoris and vastus lateralis fiber cross-sectional area

1	2	3	4	5	6	7
Hietavala et al. (2012)	Cycling	M	23.5 ±3.4	Omnivorous vs vegetarian diet	.	Ø in venous blood pH, Ø in strong ion difference, Ø total concentration of weak acids, Ø in partial pressure of CO_2 or HCO_3- at rest or during cycling, Ø exercise time to exhaustion, ↑ of VO_2 max until exhaustion
Khanna et al. (2006)	Athletes	W	16–25	Omnivorous vs lactovegetarian vs ovolactovegetarian diet	Cereals, luguminous	↓ of body mass in ovolactovegetarians Ø in energy and carbohydrate intake ↓ of protein intake in lacto- and ovolactovegetarians
Klimatskaya, Zaitseva (2015)	Yoga	W	31.9 ±7.4	Lactovegetarian	Rye, barley, buckwheat, wheat, beet, turnip, potato, onion, cabbage, peanut, berries	↓ of intake of calcium (Ca) and iron (Fe) ↑ of consumption of sodium (Na) ↓ of consumption of potassium (K)
Król et al. (2020)	Amateur running		32 ±5	Vegan vs omnivorous diet	.	Ø in excersise capacity Ø in maximal oxygen consumption ↑ of rate of oxygen consumption per kilogram of body mass ↑ of diastolic and systolic function ↓ of relative wall thicknes
Lynch et al. (2016)	Endurance athlets	M, W	21–58	Omnivorous vs vegetarian diet	.	↓ of protein intake level
Nebl et al. (2019a)	Recreative running	M, W	27.5 ±4.1	Omnivorous vs lacto-vegetarian vs vegan diet	Cereals, potato, legumes, coffee, tea	↑ of intake of carbohydrates, fiber and iron)
Nebl et al. (2019b)	Recreative running	M, W	27.5 ±4.1	Omnivorous vs lactovegetarian vs vegan diet	Cereals, legumes	↑ of intake of carbohydrates, fibre, magnesium, iron, folate and vitamin E ↓ of intake of dietary fat and vitamin B12 Ø in excersise capacity
Nebl et al. (2019c)	Recreative running	M, W	27.5 ±4.1	Omnivorous vs lactoovovegetarian vs vegan diet	Cereals, legumes	↑ of oxidative stress Ø in nitrate, nitrite and creatinine
Nebl et al. (2019d)	Recreative running	M, W	18–35	Omnivorous vs lactoovovegetarian vs vegan diet	Cereals, legumes	↑ of mean red blood cell folate ↓ of vitamin D
Potthast et al. (2020)	Recreational running	M, W	18–35	Omnivorous vs lactovegetarian vs vegan diet	Cereals, potato, legumes, coffee, tea	↑ of enzymatic activity of sirtuins (SIRT1, SIRT3, and SIRT5) during exercise in omnivores and lactoovovegetarians ↓ of enzymatic activity of sirtuins in vegans
Śliż et al. (2021)	Long-distance running	M	20–39	Omnivorous vs vegan diet	.	↓ of fat and protein intake ↑ of carbohydrates intake ↓ of body mass ↓ of C-peptide and total blood cholesterol levels

1	2	3	4	5	6	7
Yadav et al. (2020)	Recreative training	M, W	16–27	Omnivorous vs vegetarian diet	.	↑ of excercise duration ↑ of physical fitness index score
Veleba et al. (2016)	Recreative aerobic excersise	M, W		Omnivorous vs vegetarian diet	.	↑ of maximal performance ↑ of maximal oxygene consumption Ø in fasting oxidation of fat, carbohydrates and protein
Wirnitzer (2010)	Amateur cycling	W	30	Vegan	.	↑ of of energy consumption from carbochydrates
Wirnitzer et al. (2019)	Endurance running	M, W	>18	Omnivorous vs lactovegetarian vs vegan diet	.	↓ of body mass ↓ of prevalences of allergies
Woodbridge et al. (2020)	Recreational running	M, W	42.9 ±10.6	Vegan diet	.	↑ of nutritional defencies in intake of energy, protein, vitamin D and selenium ↓ of nutritional defencies in intake of iron, zinc, vitamin B12, calcium and iodine

↑ – increase, ↓ – decrease, Ø – no changes/no differences.

The acceptance of plant-based diets by athletes

Pelly and Burkhart (2014) studied the dietary regimens of athletes competing at the Delhi 2010 Commonwealth Games. They discovered that a vegetarian regimen was followed by 7% of athletes, with women in the majority. Significantly more athletes from non-Western regions followed a vegetarian diet, particularly athletes from non-Western regions of Africa, the Caribbean, India and Sri Lanka, South East Asia, and the PacificIslands. Similarly, athletes from weight category sports were more likely to follow a vegetarian/vegan dietary regimen than athletes from most other sports. Cramer, Sundberg, Schumann, Leach, Lauche (2018) found that a total of 1.7 million US yoga practitioners have used a vegetarian diet. Iwasa-Mange and Wegener (2020) investigated the knowledge and perceptions of plant-based diets among competitive and recreational athletes recruited from Canadian post-secondary institutions. The authors found that athletes have the potential to be important advocates of healthy and sustainable eating among peer groups and the general public (Table 9).

Table 9. A review of questionnaire surveys on the use of plant-based diets by sportspeople in alphabetical order

Reference	Number of respondents	Sport discipline/ category	Gender	Age	Country or region	Use of products	
						number/percent of users or use frequency	purpose
Pelly, Burkhart (2014)	351	Weight category, endurance, racquet, power/sprint, team, aesthetic and figure	M, W	24 ±6	Australia and New Zealand, British Isles, Canada, SE Asia and Pacific, India and Sri Lanka, Caribbean and Africa	7% of respondents	Religious beliefs
Cramer et al. (2018)	34,525	Yoga	M, W	>18	United States of America	8.3% of yoga practitioners	Ethical beliefs
Iwasa-Mange, Wegener (2020)	48	Competitive and recreational activity			Canada		Health and sustainable eating

Discussion

The performed literature survey seems to confirm the statement of Diazgranados et al. (2020), who suggested that numerous taxa representing kingdoms of plants, algae, bacteria and fungi are essential to human wellbeing and provide a broad spectrum of benefits to society, offering vital solutions to some of the world's major challenges including, among others, human nutrition. According to the aforementioned authors, more than 7,000 species might serve as components of human food; moreover, these edible species are frequently renowned for their health qualities. Due to the irnutritive and therapeutic effects, numerous species are frequently used in athletes' diets. Sellami, Slimeni, Pokrywka, Kuvačić, Hayes, Milic, Padulo (2018) proved that numerous species are used by athletes to enhance muscle strength and body mass, relieve muscle and joint pain, as well as activate the nervous system. According to the aforementioned authors, the group of most commonly used species is represented,among others, by ginseng (*Panax ginseng* and *Panax quinquefolius*), goat's-head (*Tribulus terrestris*), ginko (*Ginkgo biloba*), golden root (*Rhodiola rosea*), guarana (*Paullinia cupana*), green tea (*Camilla sinensis*), mate (*Ilex paraguayensis*), and caterpillar fungi (*Cordyceps sinensis*). Furthermore, previous investigations also showed that soybean (*Glycine max*) (Kostrakiewicz-Gierałt, 2020a), maize (*Zea mays*) (Kostrakiewicz-Gierałt, 2020b), as well as coneflower (*Echinacea* sp.) (Kostrakiewicz-Gierałt, 2020c) represent the base of many sport supplements and meal replacements in a variety of forms such asbars, beverages, tablets, and powders. On the other hand, several authors (Maughan, King, Lea, 2004; Garthe, 2019) pointed out that many challenges, such as contamination, undefined ingredients, and variable content of biologically active substances in herbal supplements are of great concern for athletes who are tested regularly for banned substances.

The performed review of the literature confirmed the frequent use of numerous taxa representing trees, shrubs and herbaceous plants in the preparation of many food products especially dedicated for vegan and vegetarian athletes. The evidenced most frequent use of herbaceous species corresponds with their popularity as edible plants in several regions of the world (e.g. Dénes, Papp, Babai, Czúcz, Molnár, 2012; Hong et al., 2015; Landor-Yamagata, Kowarik, Fischer, 2018; Yeşil, İnal, 2019). Contrary to the obtained results, the investigations of many authors showed that in many regions the majority of edible herbaceous plants are represented by perennial species, while annuals are rather rare. Such a tendency was observed, among others, in Estonia (Kalle, Sõukand, 2012), Poland (Łuczaj, Szymanski, 2007), and Slovakia (Łuczaj, 2012). Moreover, the presented survey shows that roots, tubers, leaves, fruits and seeds are the most frequently used parts of plants. These findings correspond with studies proving that the aforementioned parts are mostly used in the production of food from plants in numerous regions of the world (e.g. Tardío, Pascual, Morales, 2005; Della, Paraskeva-Hadjichambi, Hadjichambis, 2006; Leonti, Nebel, Rivera, Heinrich, 2006; Rivera, Bocanegra-García, Monge, 2010; Teklehaymanot, Giday, 2010; Parada, Carrió, Vallès, 2011; Turner et al., 2011; Dogan, 2012; Łuczaj et al., 2012; Vallès et al., 2017; Xu, Liang, Wang, Wen, Wang, 2020; Monti, 2021). Several authors evidenced the occurrence of nutritive compounds (sugars, proteins, fats) and antioxidants (polyphenols, carotenoids, flavones, chlorophylls, ascorbic acid) in roots and tubers (e.g. Zhao, Wu, Wang, 2015; Chandrasekara, Kumar, 2016; Chandrasekara, 2018; Xu et al., 2017), fruits and seeds (e.g. Xu et al., 2017; González-Aguilar et al., 2008; Fidelis et al., 2019; Dhalaria et al., 2020; Jideani et al., 2021), as well as leaves (e.g. Xu et al., 2017; Mateos-Maces et al., 2020) of taxa widely applied in food products used by vegan and vegetarian athletes.

The performed review evidenced that plant-based diets offer numerous desirable nutritional and health benefits. The obtained results correspond with the findings of numerous authors showing the beneficial effects of plant-based diets on cardiovascular safety and performance in endurance sports (Barnard et al., 2019). The aforementioned authors pointed out several advantages of such diets, such as a leaner body mass, facilitating of glycogen storage,improved tissue oxygenation, reduced oxidative stress, and reduced inflammation. At the same time, it should be mentioned that Craddock and Probst (2015) documented no discernible differences in athletic performance between people using vegetarian or omnivorous mixed diets. The aforementioned authors concluded that consuming a predominately vegetarian-based diet did not improve or hinder performance in athletes. Moreover, the performed overview of literature showed the occurrence of several imperfections of a vegan diet.

The performed investigations showing the reasons forchoosing plant-based diets by athletes are consistent with the investigations of Cliceri, Spinelli, Dinnella, Prescott, Monteleone (2018), who showed that positive attitudes toward plant-based dishes were positively related to empathic sensitivity towards humans and animals, as well as to attitudes towards healthy and natural products, highlighting theimportant role of food consciousness in determining eating habits.

Conclusions

1. The performed survey of patents and original articles showed the wide use of cyanobacteria and algae (organism tissue), fungi (fruiting bodies), as well as plants (roots, tubers, leaves, fruits and seeds) in manufacturing food ingredients, as well as products supplementing the diet, enhancing athletic performance, ameliorating mental alertness, improving physical health, preventing disorders, and controlling body weight.

2. The performed research indicated the occurrence of beneficial effects (e.g. the enhancement of muscle strength and endurance, reduction of risk of heart diseases, and improvement of cardiorespiratory fitness), as well as the imperfections (e.g. increase of post-exercise oxidative stress, greater risk of anaemia and osteoporosis) of non-animal diets.

3. The acceptance of vegan and vegetarian diets in athletes flows from religious and ethical beliefs, as well as the advantages of sustainable eating practices.

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References

D'Angelo, S., Cusano, P. (2020). Who practices sports can be vegetarian? *J. Hum. Sport Exerc.*, *15*, S552–S561. DOI: 10.14198/jhse.2020.15.Proc3.08.

Agnoli, C., Baroni, L., Bertini, I., Ciappellano, S., Fabbri, A., Papa, M., Pellegrini, N., Sbarbati, R., Scarino, M.L., Siani, V., Sieri, S. (2017). Position paper on vegetarian diets from the working group of the Italian Society of Human Nutrition. *Nutr Metab Carbiovasc Dis, 27* (1), 1037–1052. DOI: 10.1016/j.numecd.2017.10.020.

Banaszek, A., Townsend, J.R., Bender, D., Vantrease, W.C., Marshall, A.C., Johnson, K.D. (2019). The effects of whey vs. pea protein on physical adaptations following 8-weeks of high-intensity functional training (HIFT): A pilot study. *Sports*, 7 (1), 12. DOI: 10.3390/sports7010012,

Barnard, N.D., Goldman, D.M., Loomis, J.F., Kahleova, H., Levin, S.M., Neabore, S., Batts, T.C. (2019). Plant-based diets for cardiovascular safety and performance in endurance sports. *Nutrients*, *11* (1), 130. DOI: 10.3390/nu11010130,

Barr, S.I., Rideout, C.A. (2004). Nutritional considerations for vegetarian athletes. *Nutrition*, *20* (7–8), 696–703. DOI: 10.1016/j.nut.2004.04.015.

Bătrînu, M-G., Tero-Vescan, A., Miklos, A. (2020). Biochemical controversies regarding the use of vegetal proteins in performance athletes. *Acta Biol Marisiensis*, *3* (2), 1–9. DOI: 10.2478/abmj-2020-0006.

Bhardwaj, S., Saraswat, S. (2019). Product development, nutrient and sensory analysis of sports drink based on chia seeds (*Salvia hispanica* L.). *Int J Physiol Nutr Phys Educ*, *4* (2), 187–190.

Boutros, G.H., Landry-Duval, MA., Garzon, M. Karelis, A.D. (2020). Is a vegan diet detrimental to endurance and muscle strength? *Eur J Clin Nutr,* 74, 1550–1555. DOI: 10.1038/s41430-020-0639-y.

Brown, D.D. (2018). Nutritional considerations for the vegetarian and vegan dancer. *J Dance Med Sci T, 22* (1), 44-53. DOI: 10.12678/1089-313X.22.1.44.

Carbone, S., Candela, V., Gumina, S. (2020). Plant-based diet is it suitable for crossfit athletes? *J Phy Fit Treatment & Sports*, *8* (1), 555729. DOI: 10.19080/JPFMTS.2020.08.555729.

Carlsohn, A., Braun, H., Großhauser, M., König, D., Lampen, A., Mosler, S., Nieß, A., Oberritter, H., Schäbethal, K., Schek, A., Stehle, P., Virmani, K., Ziegenhagen, R., Heseker, H. (2019). Minerals and vitamins in sports nutrition. Position of the working group sports nutrition of the German Nutrition Society (DGE). *Ernahr. Umsch. 66* (12), 250–257. DOI: 10.4455/eu.2019.05.

Chandrasekara, A., Kumar, T.J. (2016). Roots and Tuber Crops as Functional Foods: A Review on Phytochemical Constituents and Their Potential Health Benefits. *Int J Food Sci.* DOI: 10.1155/2016/3631647.

Chandrasekara, A. (2018). Roots and Tubers as Functional Foods. In: J.M. Mérillon., K. Ramawat (eds.) *Bioactive Molecules in Food. Reference Series in Phytochemistry.* Springer, Cham. DOI: 10.1007/978-3-319-54528-8_37-1.

Chang, S-L., Nfor, O.N., Ho, C-C., Lee, K-J., Lu, W-Y., Lung, C-C., Tantoh, D.M., Hsu, S-Y., Chou, M-C., Liaw, Y-P. (2020). Combination of Exercise and Vegetarian Diet: Relationship with High Density-Lipoprotein Cholesterol in Taiwanese Adults Based on MTHFR rs1801133 Polymorphism. *Nutrients*, *12* (6), 1564. DOI: 10.3390/nu12061564.

Ciara, A.G.J. (2019). Acute weight training-induced testosterone responses of trained males across age groups and diets: A pilot study. *J Eurasia Sports Sci Med, 1* (2), 79–93.

Ciuris, C., Lynch, H.M., Wharton, C., Johnston, C.S. (2019). A comparison of dietary protein digestibility, based on DIAAS scoring, in vegetarian and non-vegetarian athletes. *Nutrients*, *11* (12), 3016. DOI: 10.3390/nu11123016.

Cliceri, D., Spinelli, S., Dinnella, C., Prescott, J., Monteleone, E. (2018). The influence of psychological traits, beliefs and taste responsiveness on implicit attitudes toward plant- and animal-based dishes among vegetarians, flexitarians and omnivores. *Food Qual Prefer*, 68, 276–291. DOI: 10.1016/j.foodqual.2018.03.020.

Craddock, J.C., Probst, Y.C. (2015). Vegetarian and omnivorous nutrition—comparing physical performance. *Int J Sport Nutr Exerc Metab, 26* (3), 212–220. DOI: 10.1123/ijsnem.2015-0231.

Craddock, J.C., Neale, E.P., Peoples, G.E., Probst, Y.C. (2020). Plant-based eating patterns and endurance performance: A focus on inflammation, oxidative stress and immune responses. *Nutr Bull*, 45 (2), 123–132. DOI: 10.1111/nbu.12427.

Craig, W., Mangels, M.A. (2009). Position of the American Dietetic Association: Vegetarian diets. *J Am Diet Assoc*, *109* (7), 1266–1282.

Cramer, H., Sundberg, T., Schumann, D., Leach, M.J., Lauche, R. (2018). Differences between vegetarian and omnivorous yoga practitioners-Results of a nationally representative survey of US adult yoga practitioners. *Complement Ther Med*, *40*, 48–52. DOI: 10.1016/j.ctim.2018.07.012.

Davey, D., Malone, S., Egan, B. (2021). Case study: Transition to a vegan diet in an elite male Gaelic football player. *Sports*, *9*, 6. DOI: 10.3390/sports9010006.

Della, A., Paraskeva-Hadjichambi, D., Hadjichambis, A.C. (2006). An ethnobotanical survey of wild edible plants of Paphos and Larnaca countryside of Cyprus. *J Ethnobiol Ethnomed, 2,* 34. DOI: 10.1186/1746-4269-2-34.

Dénes, A., Papp, N., Babai, D., Czúcz, B., Molnár, Z. (2012). Wild plants used for food by Hungarian ethnic groups living in the Carpathian Basin. *Acta Soc Bot Pol*, *81* (4), 381–396. DOI: 10.5586/asbp.2012.040.

Devrim-Lanpir, A., Hill, L., Knechtle, B. (2021). Efficacy of popular diets applied by endurance athletes on sports performance: beneficial or detrimental? A narrative review. *Nutrients*, *13* (2), 491. DOI: 10.3390/nu13020491.

Dhalaria, R., Verma, R., Kumar, D., Puri, S., Tapwal, A., Kumar, V., Nepovimova, E., Kuca, K. (2020). Bioactive compounds of edible fruits with their anti-aging properties: a comprehensive review to prolong human life. *Antioxidants*, *9* (11), 1123. DOI: 10.3390/antiox9111123.

Dinu, M., Abbate, R., Gensini, G.F., Casini, A., Sofi, F. (2017). Vegetarian, vegan diets and multiple health outcomes: A systematic review with meta-analysis of observational studies. *Crit Rev Food Sci Nutr.*, *57* (17), 3640–3649. DOI: 10.1080/10408398.2016.1138447.

Diazgranados, M., Allkin, B., Black, N., Cámara-Leret, R., Canteiro, C., Carretero, J., Eastwood, R., Hargreaves, S., Hudson, A., Milliken, W., Nesbitt, M., Ondo, I., Patmore, K., Pironon, S., Turner, R., Ulian, T. (2020). *World Checklist of Useful Plant Species*. Royal Botanic Gardens, Kew. Knowledge Network for Biocomplexity.

Dogan, Y. (2012). Traditionally used wild edible greens in the Aegean region of Turkey. *Acta Soc Bot Pol*, *81* (4), 329–342. DOI: 10.5586/asbp.2012.037.

Earnest, C.P., Morss, G.M., Wyatt, F., Jordan, A.N., Colson, S., Church, T.S., Fitzgerald, Y., Autrey, L., Jurca, R., Lucia, A. (2004). Effects of a commercial herbal-based formula on exercise performance in cyclists. *Med Sci Sports Exerc*, *36* (3), 504–509. DOI: 10.1249/01.MSS.0000125157.49280.AF.

Fidelis, M., de Moura, C., Kabbas Junior, T., Pap, N., Mattila, P., Mäkinen, S., Putnik, P., Bursać Kovačević, D., Tian, Y., Yang, B., Granato, D. (2019). Fruit seeds as sources of bioactive compounds: sustainable production of high value-added ingredients from by-products within circular economy. *Molecules*, *24* (21), 3854. DOI: 10.3390/molecules24213854.

Fuhrman, J., Ferreri, D.M. (2010). Fueling the Vegetarian (Vegan) Athlete. *Curr Sports Med Rep*, *9* (4), 233–241. DOI: 10.1249/JSR.0b013e3181e93a6f.

Forbes-Ewan, CH. (2002). Effect of vegetarian diets on performance in strength sports. Retrieved from: sportsci.org/jour/0201/cf-e.htm (8.03.2021).

Gallien, G., Bellar, D., Davis, G.R. (2017). The efficacy of a pre-workout vegan supplement on high-intensity cycling performance in healthy college-aged males. *J Diet Suppl*, *14* (6), 697–705. DOI: 10.1080/19390211.2017.1310780.

Garthe, I. (2019). Dietary supplements and elite athletes: when nature becomes high risk. *Curr Opin Endocr Metab Res*, 9, 66–7. DOI: 10.1016/j.coemr.2019.07.004.

Gibson-Smith, E., Storey, R., Ranchordas, M. (2020). Dietary intake, body composition and iron status in experienced and elite climbers. *Front Nutr*, 7, 122. DOI: 10.3389/fnut.2020.00122.

González-Aguilar, G., Robles-Sánchez, R.M., Martínez-Téllez, M.A., Olivas, G.I., Alvarez-Parrilla, E., de la Rosa, L.A. (2008). Bioactive compounds in fruits: Health benefits and effect of storage conditions. *Stewart Postharvest Rev*, *4* (3), 1–10. DOI: 10.2212/spr.2008.3.8.

Grandjean, A.C. (1987). The vegetarian athlete. *Phys Sportsmed*, *15* (5), 191–194. DOI: 10.1080/00913847.1987.11709361.

Gröber, U. (2020). Casuistry: Targeted individual IV nutrient supplementation for analysis in high performance sport. *Zeitschrift für Orthomolekulare Medizin*, *5* (3), 14–15. DOI: 10.1055/s-2007-965596.

Haub, M.D., Wells, A.M., Campbell, W.W. (2005). Beef and soy-based food supplements differentially affect serum lipoprotein-lipid profiles because of changes in carbohydrate intake and novel nutrient intake ratios in older men who resistive-train. *Metab Clin Exp, 54* (6), 769–774. DOI: 10.1016/j.metabol.2005.01.019.

Heller, S. (2019). Micronutrient needs of athletes eating plant-based diets. *Nutr Today*, *54* (1), 23–30. DOI: 10.1097/NT.0000000000000320.

Hernández-Martínez, C., Fernández-Rodríguez, L., Soriano, M.A., Martínez-Sanz, J.M. (2020). Case study: Body composition changes resulting from a nutritional intervention on a professional vegan powerlifter. *Appl. Sci*, *10* (23), 8675. DOI: 10.3390/app10238675.

Hevia-Larraín, V., Gualano, B., Longobardi, I., Gil, S., Fernandes, A.L., Costa, L.A.R., Pereira, R.M.R., Artioli, G.G., Phillips, S.M., Roschel, H. (2021). High-protein plant-based diet versus a protein-matched omnivorous diet to support resistance training adaptations: a comparison between habitual vegans and omnivores. *Sports Med*, *51* (6), 1317–1330. DOI: 10.1007/s40279-021-01434-9.

Hietavala, E.M., Puurtinen, R., Kainulainen, H., Mero, A.A. (2012). Low-protein vegetarian diet does not have a short-term effect on blood acid–base status but raises oxygen consumption during submaximal cycling. *J Int Soc Sports Nutr*, 9, 50. DOI: 10.1186/1550-2783-9-50.

Holmes, M., Willoughby, D.S. (2018). The influence of vegetarian diets on iron metabolism and supplementation in female athletes. *Journal of Exercise and Nutrition*, *1* (1), 1–17.

Hong, L., Zhuo, J., Lei, Q., Zhou, J., Ahmed, S., Wang, Ch., Long, Y., Li, F., Long, Ch. (2015). Ethnobotany of wild plants used for starting fermented beverages in Shui communities of southwest China. *J Ethnobiol Ethnomed*., 11, 42. DOI: 10.1186/s13002-015-0028-0.

Iwasa-Mange, K., Wegener, J. (2020). Knowledge and perceptions of plant-based diets among competitive and recreational athletes. *Can J Diet Pract Res*, *81* (4), 204–209. DOI: 10.3148/cjdpr-2020-016.

Jakše, B., Jakše, B. (2018). Is vegan diet appropriate for competitive artistic gymnasts? *Sci Gymnast J*, *10* (2), 153–178.

Jideani, I.O., Silungwe, H., Takalani, T., Omolola, A.O., Udeh, H.O., Anyasi, T.A. (2021). Antioxidant-rich natural fruit and vegetable products and human health. *Int J Food Prop*, *24* (1), 41–67. DOI: 10.1080/10942912.2020.1866597.

Kalle, R., Sõukand, R. (2012). Historical ethnobotanical review of wild edible plants of Estonia (1770s–1960s). Acta Soc Bot Pol. *81* (4), 271–281. DOI: 10.5586/asbp.2012.033.

Kaviani, M., Shaw, K., Chilibeck, P.D. (2020). Benefits of creatine supplementation for vegetarians compared to omnivorous athletes: a systematic review. *Int J Environ Res Public Health*, *17* (9), 3041. DOI: 10.3390/ijerph17093041.

Khanna, G.L., Lal, P.R., Kommi, K., Chakraborty, T. (2006). A comparison of a vegetarian and non-vegetarian diet in Indian female athletes in relation to exercise performance. *JESP*, *2*, 27–34.

Klimatskaya, L., Zaitseva, O. (2015). Do Siberian yoga practitioners risk health if they follow lacto vegetarian diet? *Puls Uczelni*, *9*, 8–12.

Kostrakiewicz-Gierałt, K. (2020a). An overview of soybean derived products for sportsmen. *Mov. Sports Sci. -Sci. Mot*, *109*, 23–37. DOI: 10.1051/sm/2020002.

Kostrakiewicz-Gierałt, K. (2020b). A summary of the use of maize in nutritional products for sportsmen. *Cent. Eur. J. Sport Sci. Med.*, *31* (3), 33–45. 10.18276/cej.2020.3-03.

Kostrakiewicz-Gierałt, K. (2020c). An overview of coneflower (Echinacea)-derived nutritional products for athletes and recreationally active people. In: D.K. Semwal (ed.) *Medicinal Plants: Properties, Uses and Production.* Nova Publisher, New York, USA.

Król, W., Price, S., Sliź, D., Parol, D., Konopka, M., Mamcarz, A., Wełnicki, M., Braksator, W. (2020). A Vegan Athlete's Heart – Is It Different? Morphology and Function in Echocardiography. *Diagnostics*, *10* (7), 477. DOI: 10.3390/diagnostics10070477.

Landor-Yamagata, J.L., Kowarik, I., Fischer, L.K. (2018). Urban foraging in Berlin: people, plants and practices within the metropolitan green infrastructure. *Sustainability*, *10* (6), 1873. DOI: 10.3390/su10061873.

Laquale, K.M. (2006). Practical suggestions for vegetarian athletes. *Athl Ther Today*, *11* (4), 49–60.

Larson-Meyer, D.E. (2018). Vegetarian and vegan diets for athletic training and performance. *Sports Science Exchange*, *29* (188), 1–7.

Leonti, M., Nebel, S., Rivera, D., Heinrich. M. (2006). Wild gathered food plants in the European Mediterranean: a comparative analysis. *Econ Bot*, *60* (2), 130–142. DOI: 10.1663/0013-0001(2006)60[130:WGFPIT]2.0.CO; 2.

Lis, D.M., Kings, D., Larson-Meyer, D.E. (2019). Dietary Practices Adopted by Track-and-Field Athletes: Gluten-Free, Low FODMAP, Vegetarian, and Fasting. *Int J Sport Nutr Exerc Metab*, *29* (2), 236–245. DOI: 10.1123/ijsnem.2018-0309.

Lynch, H.M., Wharton, C.M., Johnston, C.S. (2016). Cardiorespiratory fitness and peak torque differences between vegetarian and omnivore endurance athletes: A cross-sectional study. *Nutrients, 8* (11), 726. DOI: 10.3390/nu8110726.

Lynch, H., Johnston, C., Wharton, C. (2018). Plant-based diets: considerations for environmental impact, protein quality, and exercise performance. *Nutrients*, *10* (12), 1841. DOI: 10.3390/nu10121841.

Lynch, H.M., Buman, M.P., Dickinson, J.M., Ransdell, L.B., Johnston, C.S., Wharton, C.M. (2020). No significant differences in muscle growth and strength development when consuming soy and whey protein supplements matched for leucine following a 12 week resistance training program in men and women: a randomized trial. *Int. J. Environ. Res. Public Health*, *17* (11), 3871. DOI: 10.3390/ijerph17113871.

Łuczaj, Ł., Szymański, W.M. (2007). Wild vascular plants gathered for consumption in the Polish countryside: a review. *J. Ethnobiol. Ethnomed, 3* (1), 17. DOI: 10.1186/1746-4269-3-17.

Łuczaj, Ł. (2012). Ethnobotanical review of wild edible plants of Slovakia. *Acta Soc. Bot. Pol, 81* (4), 245–255. DOI: 10.5586/asbp.2012.030.

Łuczaj, Ł., Pieroni, A., Tardío, J., Pardo-de-Santayana, M., Sõukand, R., Svanberg, I., Kalle, R. (2012). Wild food plant use in 21st century Europe: the disappearance of old traditions and the search for new cuisines involving wild edibles. *Acta Soc, Bot. Pol*, *81* (4), 359–370. DOI: 10.5586/asbp.2012.031.

McGirr, C., McEvoy, C.T., Woodside, J.V. (2017). Vegetarian and Vegan Diets: Weighing the Claims. In: Temple N., Wilson T., Bray G. (eds.) *Nutrition Guide for Physicians and Related Healthcare Professionals. Nutrition and Health.* Humana Press, Cham. DOI: 10.1007/978-3-319-49929-1_20.

Mateos-Maces, L., Chávez-Servia, J.L., Vera-Guzmán, A.M., Aquino-Bolaños, E.N., Alba-Jiménez, J.E., Villagómez-González, B.B. (2020). Edible Leafy plants from Mexico as sources of antioxidant compounds, and their nutritional, nutraceutical and antimicrobial potential: a review. *Antioxidants*, *9* (6), 541. DOI: 10.3390/antiox9060541.

Maziarz, B., Chojęta, D., Zygmunt, E., Wróblewski, H., Zimna, A. (2020). Influence of vegan diet on physical performance of athletes. *J. Educ. Health Sport*, *10* (7), 209–215. DOI: 10.12775/JEHS.2020.10.07.023.

Maughan, R.J., King, D.S., Lea, T. (2004). Dietary supplements. *J. Sports Sci, 22* (1), 95–113. DOI: 10.1080/0264041031000140581.

Melina, V., Craig, W., Levin, S. (2016). Position of the Academy of Nutrition and Dietetics: Vegetarian diets. *J Acad Nutr Diet*, *116* (12), 1970–1980. DOI: 10.1016/j.jand.2016.09.025.

Meyer, N., Reguant-Closa, A. (2017). “Eat as If You Could Save the Planet and Win!” Sustainability Integration into Nutrition for Exercise and Sport. *Nutrients*, *9* (4), 412. DOI: 10.3390/nu9040412.

Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G. (2009). Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLoS Med*, *6* (7), e1000097. DOI: 10.1371/journal.pmed1000097.

Motti, R. (2021). Wild plants used as herbs and spices in italy: an ethnobotanical review. *Plants*, *10* (3), 563. DOI: 10.3390/plants10030563.

Naclerio, F., Seijo, M., Earnest, C.P., Puente-Fernández, J., Larumbe-Zabala, E. (2020). Ingesting a post-workout vegan-protein multi-ingredient expedites recovery after resistance training in trained young males. *J. Diet. Suppl*, *18* (6), 698–713 . DOI: 10.1080/19390211.2020.1832640.

Nebl, J., Schuchardt, J.P., Wasserfurth, P., Haufe, S., Eigendorf, J., Tegtbur, U., Hahn, A. (2019a). Characterization, dietary habits and nutritional intake of omnivorous, lacto-ovo vegetarian and vegan runners – a pilot study. *BMC Nutr*, *5* (1), 2–14. DOI: 10.1186/s40795-019-0313-8.

Nebl, J., Haufe, S., Eigendorf, J., Wasserfurth, P., Tegtbur, U., Hahn, A. (2019b). Exercise capacity of vegan, lacto-ovo-vegetarian and omnivorous recreational runners. *J. Int. Soc. Sports Nutr*, *16*, 23. DOI: 10.1186/s12970-019-0289-4.

Nebl, J., Drabert, K., Haufe, S., Wasserfurth, P., Eigendorf, J., Tegtbur, U., Hahn, A., Tsikas, D. (2019c). Exercise-induced oxidative stress, nitric oxide and plasma amino acid profile in recreational runners with vegetarian and non-vegetarian dietary patterns. *Nutrients*, *11* (8), 1875. DOI: 10.3390/nu11081875.

Nebl, J., Schuchardt, J.P., Ströhle, A., Wasserfurth, P., Haufe, S., Eigendorf, J., Tegtbur, U., Hahn, A. (2019d). Micronutrient status of recreational runners with vegetarian or non-vegetarian dietary patterns. *Nutrients*, *11* (5), 1146. DOI: 10.3390/nu11051146.

Nieman, D.C. (1999). Physical fitness and vegetarian diets: is there a relation? *Am. J. Clin. Nutr*, *70* (3), 570–575.

Parada, M., Carrió, E., Vallès, J. (2011). Ethnobotany of food plants in the Alt Emporda region (Catalonia, Iberian Peninsula). *J. Appl. Bot. Food Qual*, *84* (1), 11–25.

Parker, H.W., Vadiveloo, M.K. (2019). Diet quality of vegetarian diets compared with nonvegetarian diets: a systematic review. *Nutr. Rev*, *77* (3), 144–160. DOI: 10.1093/nutrit/nuy067.

Pelly, F.E., Burkhart, S.J. (2014). Dietary Regimens of Athletes Competing at the Delhi 2010 Commonwealth Games. *Int J Sport Nutr Exerc Metab*, *24* (1), 28–36. DOI: 10.1123/ijsnem.2013-0023.

Pilis, W., Stec, K., Zych, M., Pilis, A. (2014). Health benefits and risk associated with adopting a vegetarian diet. *Roczniki Państwowego Zakładu Higieny*, *65* (1), 9–14.

Phillips, F. (2005). Vegetariannutrition. *Nutr. Bull, 30* (2), 132–167. DOI: 10.1111/j.1467-3010.2005.00467.x.

Potthast, A.B., Nebl, J., Wasserfurth, P., Haufe, S., Eigendorf, J., Hahn, A., Das, A. (2020). Impact of nutrition on short-term exercise-induced sirtuin regulation: vegans differ from omnivores and lacto-ovo vegetarians. *Nutrients*, *12* (4), 1004. DOI: 10.3390/nu12041004.

Rivera, G., Bocanegra-García, V., Monge, A. (2010). Traditional plants assource of functional foods: a review. *CYTA J Food,* 2, 159–167. DOI: 10.1080/19476330903322978.

Rogerson, D. (2017). Vegan diets: practical advice for athletes and exercisers. *J. Int. Soc. Sports Nutr*, 14, 36. DOI: 10.1186/s12970-017-0192-9.

Schoenfeld, M.L. (2020). Nutritional considerations for the female vegan athlete. *Strength Cond J*, *42* (4), 68–76. DOI: 10.1519/SSC.0000000000000405.

Schroeder, K., Sonneville, K.R. (2015). Sports Nutrition. In: C. Gordon, M. LeBoff (eds.) *The Female Athlete Triad.* Springer, Boston, MA. . DOI: 10.1007/978-1-4899-7525-6_2.

Senger, E., Bohlinger, B., Esgaib, S., Hernández-Cubero, L.C., Montes, J.M., Becker, K. (2017). Chuta (edible Jatropha curcas L.), the newcomer among underutilized crops: a rich source of vegetable oil and protein for human consumption. *Eur. Food Res. Technol*, *243* (6), 987–997. DOI: 10.1007/s00217-016-2814-x.

Sellami, M., Slimeni, O., Pokrywka, A., Kuvačić, G., Hayes, L.D., Milic, M., Padulo, J. (2018). Herbal medicine for sports: a review. *J. Int. Soc. Sports Nutr*, 15, 14. DOI: 10.1186/s12970-018-0218-y.

Śliż, D., Parol, D., Wełnicki, M., Chomiuk, T., Grabowska, I., Dąbrowska, D., Król, W., Price, S., Braksator, W., Mamcarz, A. (2021). Macronutrient intake, carbohydrate metabolism and cholesterol in Polish male amateur athletes on a vegan diet. *Nutr. Bull*, *46* (2), 120–127. DOI: 10.1111/nbu.12491.

Tang, J.E., Moore, D.R., Kujbida, G.W., Tarnopolsky, M.A., Phillips, S.M. (2009). Ingestion of whey hydrolysate, casein, or soy protein isolate:effects on mixed muscle protein synthesis at rest and following resistance exercise in young men. *J. Appl. Physiol.* 107, 987–992. DOI: 10.1152/japplphysiol.00076.2009.

Tardío, J., Pascual, H., Morales, R. (2005). Wild food plants traditionally used in the province of Madrid, central Spain. *Econ. Bot*, *59* (2), 122–136. DOI: 10.1663/0013-0001(2005)059[0122:WFPTUI]2.0.CO; 2.

Teklehaymanot, T., Giday, M. (2010). Ethnobotanical study of wild edible plants of Kara and Kwego semi-pastoralist people in Lower Omo River Valley, Debub Omo Zone, SNNPR, Ethiopia. *J Ethnobiol Ethnomed,* 6, 23. DOI: 10.1186/1746-4269-6-23.

Trapp, D., Knez, W., Sinclair, W. (2010). Could a vegetarian diet reduce exercise-induced oxidative stress? A review of the literature. *J. Sports Sci*, *28* (12), 1261–1268. DOI: 10.1080/02640414.2010.507676.

Turner, N.J., Łuczaj, Ł.J., Migliorini, P., Pieroni, A., Dreon, A.L., Sacchetti, L.E., Paoletti, M.G. (2011). Edible and tended wild plants, traditional ecological knowledge and agroecology. *Cr Rev Plant Sci, 30* (1–2), 198–225. DOI: 10.1080/07352689.2011.554492.

Vallès, J., D'Ambrosio, U., Gras, A., Parada, M., Rigat, M., Serrasolses, G., Garnatje, T. (2017). *Medicinal and food plants in ethnobotany and ethnopharmacology: Folk functional foods in Catalonia (Iberian Peninsula).* In: D. Muñoz-Torrero, M. Riu, C. Feliu (eds.) Recent Advances in Pharmaceutical Sciences, 7, 1–17.

Veleba, J., Matoulek, M., Hill, M., Pelikanova, T., Kahleova, H. (2016). A vegetarian vs. conventional hypocaloric diet: the effect on physical fitness in response to aerobic exercise in patients with type 2 diabetes." A Parallel Randomized Study. *Nutrients*, *8* (11), 671. DOI: 10.3390/nu8110671.

Vanata, D.F., Mazzino, N., Bergosh, R.,Graham, P. (2014). Caffeine improves sprint-distance performance among Division II collegiate swimmers. *The Sport Journal* 17, Retrieved from: https://thesportjournal.org/article/caffeine-improves-sprint-distance-performance-among-division-ii-collegiate-swimmers.

Venderley, A.M., Campbell, W.W. (2006). Vegetarian diets – Nutritional considerations for athletes. Sports Med, *36* (4), 293–305. DOI: 10.2165/00007256-200636040-00002.

Vitale, K., Hueglin, S. (2021). Update on vegetarian and vegan athletes: a review. *J. Phys. Fit. Sports Med, 10* (1), 1–11. DOI: 10.7600/jpfsm.10.1.

Wirnitzer, K. (2010). *Nutrition strategy during an eight-day mountainbike stage race – a case study.* In: D.C. Lieberman (ed.) Aerobic Exercise And Athletic Performance: Types, Duration And Health Benefits (Sports and Athletics Preparation, Performance, and Psychology Series). Nova Science Publisher, New York, US.

Wirnitzer, K., Boldt, P., Lechleitner, Ch., Wirnitzer, G., Leitzmann, C., Rosemann, T., Knechtle, B. (2019). Health Status of Female and Male Vegetarian and Vegan Endurance Runners Compared to Omnivores – Results from the NURMI Study (Step 2). *Nutrients*, *11* (1), 29; DOI: 10.3390/nu11010029.

Wirnitzer, K. (2020). Vegan Diet in Sports and Exercise – Health Benefits and Advantag-es to Athletes and Physically Active People: A Narrative Review. *Int J Sports Exerc Med*, *6*, 165. DOI: 10.23937/2469-5718/1510165.

Woodbridge, P., Konstantaki, M., Horgan, G. (2020). Nutritional deficiencies in vegan runners: a comparison of actual versus recommended food intakes and dietary recommendations. *Br. J. Nutr, 3* (14), 1–10.

Xu, D-P., Li, Y., Meng, X., Zhou, T., Zhou, Y., Zheng, J., Zhang, J-J., Li, H-B. (2017). Natural Antioxidants in Foods and Medicinal Plants: Extraction, Assessment and Resources. *Int. J. Mol. Sci*, 1*8* (1), 96. DOI: 10.3390/ijms18010096.

Xu, Y., Liang, D., Wang, G-T., Wen, J., Wang, R-J. (2020). Nutritional and functional properties of wild food-medicine plants from the coastal region of South China. *J. Evid.-Based Integr. Med*, *25*, 1–13.

Yadav, R., Mukhopadhyay, S., Yadav, S. (2020). Physical fitness index of non-vegetarian and lacto-vegetarian adults: A comparative study of harvard step test. *Nepal Med Coll J, 22* (3), 167–172. DOI: 10.3126/nmcj.v22i3.32651.

Yeşil, Y., İnal, İ. (2019). Traditional knowledge of wild edible plants in Hasankeyf (Batman Province, Turkey). *Acta Soc. Bot. Pol,* 88 (3), 3633. DOI: 10.5586/asbp.3633.

Zhao, Y., Wu, Y.Z., Wang, M. (2015). Bioactive Substances of Plant Origin. In: P.C.K. Cheung, B.M. Mehta (eds.), *Handbook of Food Chemistry*. Springer, Berlin, Heidelberg. DOI: 10.1007/978-3-642-36605-5.

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