Palestrica of the third millennium – Civilization and Sport
Vol. 15, no. 2, April-June 2014, 112–115

Relationship between plant supplements and sports - from the perspective of PubMed publications
Relaţia dintre suplimentele din plante şi sport - din perspectiva publicaţiilor PubMed

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Abstract

Background. Plant supplements (PS) are more and more often used in sport (S), as well as in the profile research area.

Aims. The aim was the evaluation of the PS+S relationship, through the analysis of PubMed publications over the last 28 years.

Methods. The PS+S relationship over the period 1985-2013, in which, until March 2014, there were publications with this combination of keywords, was analyzed; two criteria of analysis were used: a) the criterion of time - average per year for the periods 1985-1989, 1999-1999, 2000-2009, and the number of publications per year for the years 2010, 2011, 2012, 2013; b) the criterion of PubMed filters, evaluating three PubMed filters - Text availability, Species and Sex - each of them with the corresponding subfilters.

Results. There are differences: a) between averages over 28 years: for the total number of publications (N), abstracts (A) and full-text (FT), compared with free full-text (FFT), over all analyzed periods of time; b) between publications with human subjects (H) and those with animals (An); c) between studies on males (M), females (F) and both genders (MF).

Conclusions. 1) The total number of publications over 28 years is important, 172. 2) The number of publications with FFT was reduced compared to N, A and FT. 3) Studies with H prevailed, compared to An, and the predominantly analyzed gender was M. 4) Given the growing number of publications on the relationship between herbal supplements and sport, we can deduce their importance in sports activity.

Key words: plant supplements, sports, PubMed filters.

Rezumat

Premize. Suplimentele din plante (SP) sunt tot mai frecvent utilizate în sport (S), precum şi în cercetarea de profil.

Obiective. Scopul a fost evaluarea a relaţiei SP+S, prin analiza retrospectivă a publicaţiilor PubMed din ultimii de 28 de ani.

Metodă. Relaţia SP+S a fost analizată pentru perioada 1985-2013, în care există, până în Martie 2014, publicaţii cu această combinaţie de cuvinte cheie, fiind folosite două criterii de analiză: a) criteriul timp - media per an, pentru perioadele 1985-1989, 1999-1999, 2000-2009 şi numărul de publicaţii per an, pentru anii 2010, 2011, 2012, 2013; b) Criteriul filtrelor PubMed, evaluând trei filtre PubMed - Disponibilitatea de text, Specie si Gen - fiecare dintre acestea, cu subfiltrele corespunzatoare.

Rezultate. Există diferenţe: a) între mediile pe 28 ani: pentru numărul total de publicaţii (N) pentru 1985-2013, respectiv de abstracte (A) şi de text integral (FT), comparativ cu cel cu text integral gratuit (FFT), pentru toate perioadele de timp analizate; b) între publicaţiile cu subiecţi umani (H) şi cele cu animale (An); c) între studiile care au folosit subiecţi bărbaţi (M), femei (F) sau ambele genuri (MF).

Concluzii. 1) Numărul total de publicaţii pe 28 de ani este important, 172. 2) Numărul de publicaţii cu FFT, este redus comparativ cu N, A şi FT. 3) Studiile cu H au prevalat, comparativ cu cele pe An, iar genul analizat predominant a fost M. 4) Dat fiind numărul în creştere al publicaţiilor referitoare la relaţia dintre suplimentele din plante şi sport, se poate deduce importanţa acestora în activitatea sportivă.

Cuvinte cheie: suplimente din plante, sport, filtre PubMed.

Received: 2014, May 5; *Accepted for publication:* 2014, May 30;
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Introduction

Plant supplements (PS) are more and more often used in sport (S), as well as in the profile research area. We quote, in this respect, a few recent PubMed publications, in chronological order:

"Dietary nitrate supplementation reduced resting blood pressure and improved kinetics during treadmill walking in healthy older adults but did not improve walking or cognitive performance" (Kelly et al., 2013a).

"Biostimine supplementation reduces the postexercise level of the concentration of thiobarbituric acid reactive substances by increasing the antioxidant activity of plasma but has no effect on inflammatory markers" (Basta et al., 2013).

"Dietary NO_3 (-) supplementation improves performance during intense intermittent exercise and may be a useful ergogenic aid for team sports players" (Wylie et al., 2013b).

"Dietary nitrate supplementation improved endurance during severe-intensity exercise in recreationally active subjects" (Kelly et al., 2013b).

"Both fruit, berry and vegetable juice powder supplementation and a single walking bout improved the markers of the microcirculation in these obese women" (Lamprecht et al., 2013).

"The use of beetroot juice enhances cardiovascular health and exercise performance in young adults" (Wylie et al., 2013a).

"Dietary supplementation with NO3(-)-rich BR juice speeds VO2 kinetics and enhances exercise tolerance during severe-intensity exercise when initiated from an elevated metabolic rate" (Breese et al., 2013).

The present article is the continuation of previous research of the authors concerning the assessment of the relationship between physical effort and various plant extracts through both personal studies (Jurcău et al., 2012, 2013; Jurcău & Jurcău, 2013) and analysis of PubMed publications (Jurcău, 2012).

Objectives

The aim of the present research is the evaluation of research activities for the relationship between herbal supplements and sport, through the use of the PubMed web site.

Hypothesis

Herbal supplements are a family of products increasingly used in sports, and research in this direction is on the rise.

Material and methods

The study analyzed the „plant supplements AND sport" (PS+S) relationship over 28 years, the 1985-2013 time period, between the first and last publication corresponding to this keyword combinations, and had the following elements of analysis:

a) the average number of publications per annum, for decades: 1980-89, 1990-99, 2000-2009; and the number of publications per year for the years 2010, 2011, 2012 and 2013;

b) the percentage (%) of subfilters for the analyzed keyword combinations in relation to the total number of publications, for the whole 1985-2013 period, but also for the decades and years taken into consideration.

c) some filters to check information provided by the PubMed site, namely: Text availability, Species, Sex, each of these filters forming a study group.

Within each selected check filter, some subfilters were analyzed, and for each of them, the number of publications per year was calculated, using the mentioned keywords.

1. For the *Text availability* group filter, the chosen subfilters were: the total number of publications (N), the abstract number (A), the number of publications with full text (FT) and free full text (FFT).

2. For the *Species* group filter, the chosen subfilters were: other animals (An) and humans (H).

3. For the *Sex* group filter, the chosen subfilters were: Male (M), Female (F), Male and Female (MF).

Statistical evaluation

The results obtained were analyzed using the SPSS 13.0. statistical package. For continuous data examination, Student's t test was used. The differences were considered significant at a $p< 0.05$.

Results

The data collection took place in May 2014. For all groups, data distribution was normal, according to the Kolmogorov-Smirnov test. The analysis was made on the chosen time periods.

a) Analysis of the *Text availability* filter (Tables I and II)

The total number of publications over 28 years was 172 (N), followed in terms of value by FT (159), representing 92.4% of N, then by A (156), 90.6%. FFT represented only 20.4% of N.

The analysis of the percentage (%) of subfilters in relation to N shows that the highest percentage was recorded: in 2010 for FT (100%) and FFT (21%), and in 2013 for A (100%). The lowest percentage was recorded in 2012 for FFT (13%).

Table I

Percentages of subfilters in relation to N *Text availability* filter.

Time period	N	A	FT	FFT
1985-2013	100	90.6	92.4	20.4
1985-2009	100	91	89	17
2010	100	89.4	100	21
2011	100	88	96.8	30
2012	100	91.3	95.6	13
2013	100	100	95	30

Table II

Analysis of the number of publications, with the *Text availability* filter, in relation to FFT.

Time period	N	A	FT	FFT
1985-2013	172	156	159	35
1985-1989	0.2	0.1	0.1	0
1990-1999	0.2	0.2	0.1	0
2000-2009	8.6	7.9	7.8	1.5
2010	19	17	19	4
2011	31	27	30	9
2012	23	21	22	3
2013	20	20	19	6
Mean	14.5714	13.3142	14	3.3571
Standard deviation	10.9463	9.8602	10.656	3.0556
P-value	0.016	0.017	0.018	

Significant differences were noted for the averages over 28 years between N and FFT ($p = 0.016$), A and FFT ($p = 0.017$), FT and FFT ($p = 0.018$). During the period

1985-1999, no publication had FFT. The dynamic analysis of the number of publications over 28 years shows that N, A, FT and FFT began to grow from the period 2000-2009 to 2010, reached the highest value in 2011, and slightly decreased over the past two years.

b) Analysis of the *Species* filter (Tables III and IV)

The total number of publications over 28 years in which the H subfilter was mentioned was 150, representing 88% of N.

The analysis of the percentage (%) of subfilters in relation to N shows that the highest percentage was recorded: in 2012 for An (30.4%) and in 2010 for H (94.6%). The lowest percentage was recorded in 2010 for An (5.3%).

Table III

Percentages of subfilters in relation to N, *Species* filter.

Time period	N	An	H
1985-2013	100	53.3	88
1985-2009	100	15.6	88.9
2010	100	5.3	94.6
2011	100	22.6	93.5
2012	100	30.4	72.9
2013	100	20	70

There were no studies with An in the period 1985-1999. The largest number of publications with An was in 2011 and 2012 (7), and with H in 2011 (29). Only the difference between N and the number of publications with An was significant (0.013).

Table IV

Analysis of the number of publications with the *Species* filter, in relation to N.

Time period	N	An	H
1985-2013	172	31	150
1985-1989	0.2	0	0.2
1990-1999	0.2	0	0.2
2000-2009	8.6	1.4	7.6
2010	19	1	18
2011	31	7	29
2012	23	7	17
2013	20	4	14
Mean	14.5714	2.9142	12.2857
Standard deviation	10.9463	2.8662	9.6456
P-value		0.013	ns

c) Analysis of the *Sex* filter (Tables V and VI)

The highest number of publications over 28 years was found for both filters, M and F (112), which represents 59.8% of N, followed in terms of value by M (102), 52.8% of N, and by F (46), 33.9% of N.

Table V

Percentages of subfilters in relation to N, *Sex* filter.

Time period	N	M	F	MF
1985-2013	100	59.3	26.8	65.1
1985-2009	100	62	28	66
2010	100	63.1	31.6	78.9
2011	100	71	29.1	78
2012	100	48	21.8	56.6
2013	100	50	20	55

The analysis of the percentage (%) of subfilters in relation to N demonstrates that the highest percentage was recorded: in 2011 for M (71%), and in 2010 for F (31.6%) and for MF (78.9%). The lowest percentage was found in 2013 for F (20%).

The number of publications with M was higher than that with F, for the entire period of time. During all analyzed years, studies with both M and F were performed. The differences were significant only between N and F ($p = 0.019$).

Table VI

Analysis of the number of publications, with the *Sex* filter, in relation to N.

Time period	N	M	F	MF
1985-2013	172	102	46	112
1985-1989	0.2	0.1	0.1	0.1
1990-1999	0.2	0.1	0.1	0.1
2000-2009	8.6	5.3	2.3	5.7
2010	19	12	6	15
2011	31	22	9	24
2012	23	11	5	13
2013	20	10	4	11
Mean	14.5714	8.6428	3.7857	9.8428
Standard deviation	10.9463	7.1135	2.998	7.9761
P-value		ns	0.019	ns

Discussion

The dynamic evolution of N, A, FT and FFT shows that between 1985-2013, so for a period of 28 years, the number of studies including these subfilters for the keywords „plant supplements AND sport" (PS+S) was important (N=172). There was no FFT recorded between 1985-1999. The interest in these subfilters began to grow in the period 2000-2009. The average number of N publications per year was the highest in 2011 (31). Of these publications, the number of FFT was constantly lower, compared to N, A and FT. Thus, the difficulty of access to full text information can be noted for these publications without FFT.

The dynamic evolution of H shows that between 1985-2013, so for a period of 28 years, the number of studies including these subfilters for the keywords „plant supplements AND sport" (PS+S) was important (150). Although animal studies related to the combination of the chosen words were also present permanently, their number was always lower compared to those with human subjects. During the 1985-1999 period, there were no studies with animals. The interest in these subfilters began to grow in the period 2000-2009, the average number of publications with H per year being the highest in 2011 (29).

In 2013, there were 4 publications with An (Campbell et al., 2013; Mahmoody et al., 2013; Malardé et al., 2013; Xu et al., 2013) and 14 with H (Basta et al., 2013; Derosa G et al., 2013; Gleeson, 2013; Gleeson, Williams, 2013; Kaats et al., 2013; Kelly et al., 2013; Kelly et al., 2013; Knab et al., 2013; Koncic, Tomczyk, 2013; Lamprecht et al., 2013; Malardé et al., 2013; Wylie et al., 2013; Wylie et al., 2013; Xu et al., 2013).

The dynamic evolution of M, F and MF shows that between 1985-2013, so for a period of 28 years, the number of studies including these subfilters for the keywords „plant supplements AND sport" (PS+S) was important (112 for MF). The interest in these subfilters began to grow in the period 2000-2009, the average number of publications per year being the highest in 2011 for all subfilters, M (22), F (9) and MF (24). MF values were permanently higher compared to M and F. Although there were studies for both genders with respect to the combination of the chosen

words, the number of studies with M was always greater compared to those with F. It is a fact that, in the case of the „plant supplements AND sport" keywords, studies having both M and F subjects were preferred.

In 2013, there were 10 publications with M (Basta et al., 2013; Breese et al., 2013; Derosa et al., 2013; Kelly et al., 2013; Kelly et al., 2013; Knab et al., 2013; Malardé et al., 2013; Wylie et al., 2013; Wylie et al., 2013; Xu et al., 2013), 4 with F (Derosa et al., 2013; Kelly et al., 2013; Lamprecht et al., 2013; Wylie et al., 2013) and 11 with MF (Basta et al., 2013; Breese et al., 2013; Derosa et al., 2013; Kelly et al., 2013; Kelly et al., 2013; Knab et al., 2013; Lamprecht et al., 2013; Malardé et al., 2013; Wylie et al., 2013; Wylie et al., 2013; Xu et al., 2013).

The evaluation of the relationship between herbal supplements and sport demonstrates, by the growing number of publications, the interest in this subject, which although began to be studied relatively recently, starting with 1985, represents a cross-domain issue.

Conclusions

1. The total number of publications over 28 years is important, 172.

2. The number of FFT publications was low compared to N, A and FT publications.

3. Studies with H prevailed, compared to An, and the predominantly analyzed gender was M.

4. Given the growing number of publications on the relationship between herbal supplements and sport, we can deduce their importance in sports activity.

Conflicts of interest

Nothing to declare.

Acknowledgement

We address our thanks to Mr. Nicolae Colceriu, Eng. Ph.D, at USAMV Cluj-Napoca, for the statistical processing of the results.

References

Basta P, Pilaczyńska-Szczęśniak Ł, Woitas-Ślubowska D, Skarpańska-Stejnborn A. Influence of Aloe arborescens Mill. extract on selected parameters of pro-oxidant-antioxidant equilibrium and cytokine synthesis in rowers. Int J Sport Nutr Exerc Metab. 2013;23(4):388-98.

Breese BC, McNarry MA, Marwood S, Blackwell JR, Bailey SJ, Jones AM. Beetroot juice supplementation speeds O2 uptake kinetics and improves exercise tolerance during severe-intensity exercise initiated from an elevated metabolic rate. Am J Physiol Regul Integr Comp Physiol. 2013;305(12):R1441-50. doi:10.1152/ajpregu.00295.2013.

Campbell SC, Bakhshalian N, Sadaat RL, Lerner MR, Lightfoot SA, Brackett D, Arjmandi BH. Flaxseed reverses atherosclerotic lesion formation and lowers lipoprotein(a) in ovarian hormone deficiency. Menopause. 2013;20(11):1176-83. doi: 10.1097/GME.0b013e31828cef8d. PubMed PMID: 23571520.

Derosa G, Bonaventura A, Bianchi L, Romano D, D'Angelo A, Fogari E, Maffioli P. Berberis aristata/Silybum marianum fixed combination on lipid profile and insulin secretion in dyslipidemic patients. Expert Opin Biol Ther. 2013;13(11):1495-506. doi: 10.1517/14712598.2013.832751.

Gleeson M, Williams C. Intense exercise training and immune function. Nestle Nutr Inst Workshop Ser. 2013;76:39-50. doi: 10.1159/000350254. Epub 2013 Jul 25.

Gleeson M. Nutritional support to maintain proper immune status during intense training. Nestle Nutr Inst Workshop Ser. 2013;75:85-97. doi: 10.1159/000345822.

Jurcău R, Jurcău I, Bodescu C. Anxiety and salivary cortisol modulation, in stress sports, by the help of a phytotherapic produce that contains Rhodiola Rosea. Palestrica Mileniului III. 2012;13(3):213-218.

Jurcău R, Jurcău I, Ormenişan S, Colceriu N, Papuc P. Modulation of physical stress, through a phyto energetical preparation, containing Schisandra Chinensis.Studis Universitatis Babeş-Bolyai, Bioethica. 2013;1:51-60.

Jurcău R, Jurcău I. Influence of moderate physical exertion on subacute low back pain, after Symphytum officinale ointment treatment. Palestrica Mileniului III. 2013;14(3):175-180.

Jurcău R. The relationship between sports and polyphenols, retrospective analysis of PubMed publications of the last 52 years. Palestrica Mileniului III. 2012;13(3):339-347.

Kaats GR, Miller H, Preuss HG, Stohs SJ. A 60day double-blind, placebo-controlled safety study involving Citrus aurantium (bitter orange) extract. Food Chem Toxicol. 2013;55:358-62. doi: 10.1016/j.fct.2013.01.013.

Kelly J, Fulford J, Vanhatalo A, Blackwell JR, French O, Bailey SJ, Gilchrist M, Winyard PG, Jones AM. Effects of short-term dietary nitrate supplementation on blood pressure, O2 uptake kinetics, and muscle and cognitive function in older adults. Am J Physiol Regul Integr Comp Physiol. 2013a;304(2):R73-83. doi:10.1152/ajpregu.00406.2012.

Kelly J, Vanhatalo A, Wilkerson DP, Wylie LJ, Jones AM. Effects of nitrate on the power-duration relationship for severe-intensity exercise. Med Sci Sports Exerc. 2013b;45(9):1798-806. doi: 10.1249/MSS.0b013e31828e885c.

Knab AM, Nieman DC, Gillitt ND, Shanely RA, Cialdella-Kam L, Henson DA, Sha W. Effects of a flavonoid-rich juice on inflammation, oxidative stress, and immunity in elite swimmers: a metabolomics-based approach. Int J Sport Nutr Exerc Metab. 2013;23(2):150-60.

Koncic MZ, Tomczyk M. New insights into dietary supplements used in sport: active substances, pharmacological and side effects. Curr Drug Targets. 2013;14(9):1079-92.

Lamprecht M, Obermayer G, Steinbauer K, Cvirn G, Hofmann L, Ledinski G, Greilberger JF, Hallstroem S. Supplementation with a juice powder concentrate and exercise decrease oxidation and inflammation, and improve the microcirculation in obese women: randomised controlled trial data. Br J Nutr. 2013;110(9):1685-95. doi: 10.1017/S0007114513001001.

Mahmoody SA, Gharakhanlou R, Roshan VD, Hedayati M. Individual and concomitant effects of cardioprotective programs on cardiac apelinergic system and oxidative state in L-NAME-induced hypertension. Clin Exp Hypertens. 2013;35(1):20-7. doi:10.3109/10641963.2012.685536.

Malardé L, Vincent S, Lefeuvre-Orfila L, Efstathiou T, Groussard C, Gratas-Delamarche A. A fermented soy permeate improves the skeletal muscle glucose level without restoring the glycogen content in streptozotocin-induced diabetic rats. J Med Food. 2013;16(2):176-9. doi: 10.1089/jmf.2012.0095.

Wylie LJ, Kelly J, Bailey SJ, Blackwell JR, Skiba PF, Winyard PG, Jeukendrup AE, Vanhatalo A, Jones AM. Beetroot juice and exercise: pharmacodynamic and dose-response relationships. J Appl Physiol (1985). 2013a;115(3):325-36. doi: 10.1152/japplphysiol.00372.2013.

Wylie LJ, Mohr M, Krustrup P, Jackman SR, Ermıdis G, Kelly J, Black MI, Bailey SJ, Vanhatalo A, Jones AM. Dietary nitrate supplementation improves team sport-specific intense intermittent exercise performance. Eur J Appl Physiol. 2013b;113(7):1673-84. doi: 10.1007/s00421-013-2589-8.

Xu C, Lv J, You S, Zhao Q, Chen X, Hu X. Supplementation with oat protein ameliorates exercise-induced fatigue in mice. Food Funct. 2013;4(2):303-9. doi: 10.1039/c2fo30255a.