Egypt. J. Chem. **Vol. 68**, No.2 pp. 515-524 (2025)

Egyptian Journal of Chemistry

http://ejchem.journals.ekb.eg/

Effectiveness of some Dietary Ergogenic in Enhancing Weightlifter Athletes Performance

Hanem M. Gharib [1*], Abd El-Daim Yosry A.[1], Ashoush, Ihab S.[1], Abdel-Salam, Ahmed M. [2]

[1]Food Sciences Dept., Fac. of Agric., Ain Shams Univ., P.O. Box 68, Hadayek Shobra 11241, Cairo, Egypt
[2]Dairy Science Department, Food Industries and Nutritional Research Institute, National Research Center, Cairo, Egypt.

Abstract

The study aims to determine the effects of natural dietary supplements on endurance performance for weightlifter athletes, therefor, prepared capsule consisting of blended ratio from the powders of probiotics, wheat germ, dandelion, ginseng root, moringa seeds, taurine, spirulina, fenugreek sprout, carob fruit, doum fruit, buckthorn fruit, whey protein isolate and date pits, that are taken orally in capsule form by weightlifting athletes participated in this study for six weeks, male (n= 11) and female (n= 14). The prepared capsule examined for proximate analyses, polyphenols content, amino acids composition and antioxidant status. Also, some anthropometric measurements for male and female athletes were determined. Furthermore, snatch and clean and jerk performances of the athletes were recorded. The results showed that, the suggested dietary supplement capsule had the highest antioxidant activity (116.97 µmole Trolox/g), as well as significant increases in total flavonoid and phenolic content (17.0 mg QUE/g and 25.65 mg GAE/g) and total chlorophyll (2.07 mg/g). Moreover, the dietary supplement capsule consists of a mixture of a wide range of important phenolic compounds. Besides, the composition of amino acids revealed high content from branched-chain amino acids (BCAAs) in the dietary capsule. On the other hand, anthropometric measurements showed that males had greater weight and height than females, also, male was significantly more circumferential around the waist and upper arms than females; in additional, male who lifted weights had significantly larger muscles than females; both genders lifted more weight over the course of six weeks; and male were significantly more efficient at lifting heavier weights than females through snatch and clean and jerk performances. Thus, the results indicated that by incorporating natural dietary supplement powders in the suggested capsule, it is possible to enhance the performance of weightlifter athletes.

Keywords: Dietary Ergogenic, Probiotic, Phytochemical, Weightlifter athletes, Anthropometric, Physical performance

1. Introduction

The study of the connection between dietary intake and physical exercise capacity is known as sports nutrition. The impact of nutrients on energy metabolism, muscle function, and recovery after exercise is examined. These nutrients include carbs, proteins, fats, vitamins, and minerals. The goal of research on sports nutrition is to ascertain which nutrients athletes should consume in accordance with their body composition, performance objectives, and training regimen. It also takes into account the effects of different eating habits on sports performance **[1]**. Olympic weightlifting, the two fundamental skills are clean and the jerk. This skill requires nutritional, physiological, psychological, pharmacological, and biomechanical support to reach peak performance in training and competition. Olympic weightlifting techniques require instantaneous energy when lifting the maximum amount of weight with an absolute and dynamic strength motion. Support in the form of nutrition, psychology, and medication can improve performance and raise the chances of winning competitions. Olympic weightlifting performance is impacted by ergogenic assistance. Thus, supplementing with dietary ergogenic to improve training and performance in competition is warranted **[2]**. Date pits (*Phoenix dactylifera*) contain valuable bioactive compounds, date pits accumulate in very large quantities. offering features like better fat, protein, fiber, vitamin, mineral, polyphenol, and antioxidant composition. Date pits have additionally been employed as an emulsifying agent, hydrocolloid, tenderizing agent, fat substitute, and natural preservative. Antioxidant capacity, dietary fiber content, and probiotic enhancement through dietary fibers are some of their health-promoting properties **[3]**.

Ginseng (Panax ginseng) affects Excitability and muscle strength during eccentric exercise as well as the delayed onset of pain and subsequent damage to the muscles. discovered that in athletes with extensive training, ginseng speeds up the recovery of muscle strength after eccentric exercise, increases muscle excitability, and decreases perceived exertion **[4]**.

Taurine acid (2-aminoethane sulfonic acid-C2H7NO3S) is obtained from the metabolism of methionine and cysteine. Along with influencing energy metabolism in skeletal muscle, adipose tissue, the liver, and other tissues, it has also been reported to have anti-inflammatory qualities and to protect against a variety of neurotoxic insults **[5, 6]**. The impact of taurine on exercise-related outcomes has been studied by **[7, 8]**. Fenugreek sprouts (*Trigonella foenum* graecum) are a promising source of bioactive phytochemicals, which accounts for their historical application in the treatment of cancer and other metabolic

*Corresponding author e-mail: hanemma4983@gmail.com .; (Hanem, M. Gharib).
Receive Date: 09 May 2024, Revise Date: 27 June 2024, Accept Date: 08 July 2024
DOI: 10.21608/ejchem.2024.288109.9695

illnesses. Fenugreek sprouts are an underutilized source of bioactive compounds and illustrate the potential anti-cancer effects of fenugreek seeds and sprouts **[9]**.
Moringa (*Moringa oleifera*) seeds have a high protein content of approximately 52%, containing all essential amino acids. They could serve as an excellent source of functional protein isolate and hydrolysates for use in food and biomedical industries. Additionally, moringa seed proteins have been found to possess antimicrobial, antioxidant, antiviral, antidiabetic, hepatoprotective, anticancer, and cardio-protective properties **[10]**.
Why protein isolate (WPI) had substantial content with branch chain amino acids (BCAAs), which are crucial for athletes, are abundant in whey protein. First used during periods of exercise and resistance training, BCAAs are metabolized directly into muscle tissue. Whey proteins are a great source of essential amino acids, particularly leucine, arginine, and lysine. Essential amino acids give athletes the energy they need to train harder and longer **[11]**.
Royal jelly is used in the food, cosmetics, and pharmaceutical industries because of its exceptional biological properties. Numerous research studies attest to the potential anti-aging, antibacterial, anti-fatigue, anti-inflammatory and antioxidant. The bioactive ingredients it contains are primarily responsible for these actions. major royal jelly proteins (MRJPs), one of the main bioactive ingredients **[12]**. Spirulina (Spirulina spp.) healthy food supply that is rich in nutrients. Its high nutritional content which includes essential fatty acids, carotenoids, chlorophyll, and xanthophyll's as well as its essential protein, vitamins, and minerals make it a great option for supplemental food in product formulations. Up until now, it has been tested in a range of food products, such as sports supplements **[13]**. Wheat germ is a dependable daily intake source of polyamines. Therefore, daily administration could be advised to encourage the growth of new cells in the skin, hair, and nails as well as to prevent cancer, chronic neurological, inflammatory, and cardiovascular diseases. For promoting muscle growth, infant development, and cell proliferation, this polyamine-rich source may also be recommended to athletes **[14]**.

Probiotics (*lactobacillus acidophilus*, *bifidobacterium breve* and *bifidobacterium longum*) have the potential to lower the risk of respiratory and gastrointestinal disorders during the demanding times of competition and training. Probiotics clinical benefits are most likely mediated by altered gut microbiota and improved respiratory and gastrointestinal mucosal barrier integrity. Practical concerns with probiotic supplementation include evaluating each athlete's health and diet, exposing them to probiotics well in advance of competition to determine each person's tolerance and potential adverse effects, and daily monitoring during times of intense training and competition **[15]**. Dandelion (*taraxacum officinale*) has shown a multitude of characteristics, such as its ability to modulate inflammation, diuretic, stimulate digestion, prebiotic, and immunomodulator. Dandelion root and leaf may lower the atherogenic index and guard against oxidative stress-related atherosclerosis. The dandelion plant has yielded several flavonoids, such as luteolin, caffeic acid, chlorogenic acid, and luteolin 7-glucoside **[16]**.

Carob fruit (*Ceratonia silique*) had a variety of bioactive substances, including polyphenols, as well as sugars and dietary fiber are found in carob. Because of its anti-hyperglycemic, antioxidant, and anti-inflammatory properties, bioactive compounds found in carob fruit and its derivatives help manage a variety of health issues, therefore, using carob products as a functional food ingredient has a lot of potential **[17]**. Doum palm fruit (*Hyphaene thebaica*) higher levels of ash, amino acids, proteins, and vitamin C were found in the pulp without pericarp; on the other hand, the pulp of whole fresh fruit had higher levels of calcium (1.67 mg/g), sodium (640 mg/g), and zinc (11 μg/g). DPPH revealed significantly stronger antioxidant activity in fruit pulp that was purchased from the local market **[18]**. Buckthorn (Ziziphus spina-chrisit) fruits powder is rich in energy compounds 80.6% (carbohydrates, including fructose, glucose, sucrose, and starch) **[19]**. Moreover, each 100 grams of dried fruit contains 0.9 mg fat, 4.8 mg protein, 140 mg calcium, 0.13 mg riboflavin, 0.04 mg thiamine, and 3.7 mg niacin **[20, 21]**. The fruit had a high vitamin C content (98 mg) and a rich amount of polyphenols with scavenging ability against free radicals as reported by many literature **[22, 23, 24]**.

Therefore, this study aims to determine the phytochemical activity of potential natural dietary ergogenic in capsule form on endurance performance for weightlifter's athletes.

2. Materials and Methods

2.1. Materials

2.1.1. Date-pits:

Date palm fruits variety "Barhi" were obtained from Agriculture Research center (ARC), Giza Governorate, Egypt. Date-pits were removed and ground using a specialized grinder that is available at the El-Sahel region's feed department in Cairo, Egypt.

2.1.2. Ginseng roots:

Korean red ginseng roots (4 years) were furthered and powdered at Harraz Planta Medical Group, Cairo, Egypt.

2.1.3. Moringa seeds, Spirulina and Whey protein isolate (WPI):

Powdered moringa seeds, Spirulina and WPI were brought from National Research Centre, Cairo, Egypt.

2.1.4. Taurine and probiotic:

Taurine acid and probiotic (*lactobacillus acidophilus*, *bifidobacterium breve* and *bifidobacterium longum*) were obtained from Max muscle co. Giza, Egypt.

2.1.5. Wheat germ:

Wheat germ powder was obtained from El-Khattab mills company six October, Giza, Egypt.

2.1.6. Fenugreek plant:
Fenugreek were brought from Harraz Planta Medical Group, Cairo, Egypt. Fenugreek seeds were germinated for 4 days, then the plant was dried inside the oven at a temperature of 48 ºC for 24 hours, then it was ground into a powder.

2.1.7. Other natural sources:
Powders of royal jelly, Dandelion, Carob, Doum palm and Buckthorn fruits were purchased from Harraz Plant Medical Group, Cairo, Egypt.

2.2. Preparation of the dietary ergogenic capsule
The 1st step, the eighth natural dietary supplement powders including (ginseng, Fenugreek, Carob, Dandelion, Spirulina, Doum palm, Buckthorn, Date palm) were mixed by ratio then extraction was done for the materials by using methods **[25]**. using absolute alcohol, then, the extract was lyophilized, and the obtained compounds was loaded onto whey protein. The 2nd steps, the other six natural dietary supplement powders including (Taurine, royal jelly, WPI, moringa seeds, Wheat germ, probiotic) mixed by ratio with lyophilized extract compounds to prepare the dietary ergogenic capsule.

2.3. Proximate analyses of dietary ergogenic capsule
Natural dietary supplement powders were analyzed for their moisture content, ash, crude fiber, protein and fat contents; while, Carbohydrates were calculated by difference using the following equation: % Total carbohydrates =100 – [% moisture + % ash + % protein + % fat + crude fiber], according to the methods described in **[25]**. The calorie value was calculated by the formula as follows:
Calorie value (kcal/100 gm) = (4 x % protein) + (9 x % fat) + (4 x % carbohydrate).

2.4. Dietary ergogenic capsule extraction
The dietary supplement capsule was extracted with methanol (70%) with shaking the mixture for one hour then filtered with Whatman No.1 filter paper as described by **[26]**. The extracts were labeled and kept for laboratory analysis.

2.5. Determination polyphenols content of dietary ergogenic capsule by HPLC
The phenolic compounds content of dietary supplement capsule was analyzed using HPLC in Agricultural, Cairo University, the environmental conditions were 25°C and humidity: 38% hr. Agilent 1260 Infinity HPLC Series (Agilent, USA), equipped with Quaternary pump, the column used akinetex-R 5µm EVO C18 100mm×4.6mm. (Phenomenex, USA), operated at 30°C. The separation is achieved using a ternary linear elution gradient with (A) HPLC grade water 0.2% H3PO4 (v/v), (B) methanol, and (C) acetonitrile. The injected volume was 20µL. Detection: VWD detector set at 284nm.

2.6. Determination of Amino acids composition for dietary ergogenic capsule
The Amino acids composition was carried out using the HPLC-Pico-Tag method described by **[27, 28, 29]**. The pre-column derivatization was carried out using phenyl isothiocyanate reagent (PITC). Separation, detection and identification of amino acids was carried out using reversed-phase gradient elution high-performance liquid chromatography (HPLC) with Pico-Tag amino acids column and fixed wavelength of 254 nm (2489 UV/Vis Detector), The illustrated was calibrated using two injections of amino acid standards prior to the sample being injected.
Estimation of Tryptophan:
Tryptophan content of samples was determined calorimetrically according to the method described by **[30]**.
Computed protein efficiency ratio (C-PER):
C-PER was estimated as described by **[31]**, following the equation:
C-PER = -0.684+0.456 (Leucine) -0.047 (proline).
Computed Biological value (BV):
Biological value was estimated as described by **[32]**, according to the following equation:
BV =49.9+10.53C-PER.

2.7. Determination antioxidant status of dietary ergogenic capsule
2.7.1. The total phenolic content:
The total phenolic content of the extracts was calorimetrically determined, using the Folin-Ciocalteu method, described by **[33]**. Aliquots of 0.5 ml sample extract were added to 0.5 ml of folin reagent, followed by adding 0.5 ml of an aqueous 7.5% solution of sodium carbonate. The mixture was stirred and allowed to stand for 30 min. The absorbance at 765 nm, blank sample consisting of water and reagents was used as a reference. The results were expressed as milligrams of gallic acid equivalent per ml extract (mg GAE/ml) by reference to the gallic acid calibration curve.

2.7.2. Total flavonoids content (TFC) assay:
Total flavonoids content (TFC) assay for dietary ergogenic capsule was determined according to the method of **[34].** A 100 µL aliquot of 2% $AlCl_3$ ethanolic solution was added to 100 µL of the extract and mixed well. After keeping for 1 h at room temperature, the absorbance at 420 nm was measured. A yellow color indicates the presence of flavonoids. The total flavonoid contents were expressed as milligram quercetin equivalents (QE).

2.7.3. Total Chlorophyll and Carotenoids Measurement
Chlorophylls and carotenoids were measured in dietary ergogenic capsule. A sample of 1 g was ground in 10 mL acetones (80% v/v) and filtered supernatants were taken (3 mL) in glass cuvette. Finally, absorption of each sample at wavelength of

663, 645, and 470 nm on Spectrophotometer was recorded. Total chlorophyll, chlorophylls (a and b) and carotenoids were calculated by using the equation described by **[35, 36]** as following:
Chlorophyll A =11.75*(OD_{663nm}) – 2.35*(OD_{645nm})
Chlorophyll B = 18.61*(OD_{645nm}) -3.96*(OD_{663nm})
Total Carotenoids = 1000*(OD_{470nm}) - 3.27*(Chlorophyll A)-81.4*(Chlorophyll B).

2.7.4. DPPH-radical scavenging activity:
DPPH-radical scavenging activity (%) in dietary ergogenic capsule was determined according to **[37]**. Aliquots 0.1 ml of sample extract was mixed with 2.9 ml of 0.1 mM DPPH in methanol. The control samples contained all the reagents except the extract. The reaction mixture was shaken well and allowed to react for 20 min at room temperature. The remaining DPPH free radical was determined by absorbance measurement at 517 nm against methanol blank. The percentage scavenging effect was calculated from the decreased absorbance against control according to the following equation:
Scavenging activity % = [($Abs_{control}$ - Abs_{sample})/$Abs_{control}$] x 100

2.8. Study design and subjects:
The study was conducted on male (n= 11) and female (n=14) weightlifting athletes aged from 14 to 20 years. Trained in the athletics championship. The sector belongs to the Armed Forces of the Ministry of Defense of the city of Ismailia. Ismailia, Egypt. The indicated dose was 1-2 recommended dietary supplement capsules (Half a gram) was taken daily by weightlifters. The trial period was extended to 6 weeks. This study was approved by the Ethics Committee for Athletics Championships.

2.10. Anthropometric measures for weightlifting athletes:
Anthropometric measurements included body weight, height, Body mass index (BMI) and ideal body weight percentage (IBW%), Waist circumference, Hip circumference, Waist-to-Hip Ratio (WHR), Waist-to-Height Ratio (WHtR) and Mid upper arm circumference index (MUAC). All circumferences were measured with an anthropometric tape measure. All measurements were performed according to the techniques described by **[38, 39, 40]**.

2.11. Determination of body composition
Body composition was determined using skinfold measurement. Skin folds were measured in millimeters at four locations on the body (biceps, triceps, Subscapular and suprailiac) using the Lange Skinfold Caliper at constant tension. Various components of body composition were assessed using standardized equations according to **[41, 42]**.

2.12. Physical performance parameters for weightlifting athletes
The one recommended parameter used to evaluate weightlifter performance Clean & Jerk were evaluated and recorded starting the evaluation after 6 weeks of taking the recommended nutritional supplement capsule.

2.13. Statistical analysis
Descriptive values of data were represented as means ± standard errors. Statistical analysis was performed using one way analysis of variance (ANOVA) followed by Duncan's multiple range test with $P \leq 0.05$ being considered statistically significant **[43]**. Statistical analysis was conducted with SAS program **[44]**.

3. Results and Discussion
3.1. Proximate composition of dietary ergogenic capsule
Proximate analysis of dietary ergogenic capsule was presented in **(Table 1)**. It could be noticed that a moisture content of 7.63 %, an appreciable amount of carbohydrate 46.36 %, crude protein 32.6 %, a moderate presence of crude fiber 14.19 %, ash content 1.79 %, and crude fat 5.06 %. These results in the same trends with **[45]**, who illustrated that, Carob pulp contained moisture (6–10%), ash (1–6%), protein (1–5%), fat (0.4–0.8%), also, the results of proximate analysis for Buckthorn fruits powder revealed 76.5% carbohydrates, 5.4% protein, 13.3% moisture, and 0.66% fat **[46]**. Doum fruits are incredibly significantly rich in total carbohydrates **[18]**.

Table 1: Proximate composition % of dietary ergogenic capsule

Composition	dietary ergogenic capsule Component % on DW* basic
Moisture	7.63±0.03
Ash	1.79±0.01
Fat	5.06±0.01
Protein	32.6±0.01
Fiber	14.19±0.01
Carbohydrate	46.36±0.03
Calorie value (kcal/100g)	361.4±0.02

Data are mean ± SE, n=3; *DW: Dry weight

3.2. Antioxidant status of dietary ergogenic capsule

The results of the antioxidant status assessment in **Table (2).** showed high content of total phenols, total flavonoids and had a great of antioxidant activity for the proposed dietary supplement capsule used in the study are shown in Table (2). From this table the nutritional supplements used to prepare the capsule are recommended considering their total phenolic content. When the natural sources were mixed in the recommended proportions to prepare an oral capsule, a capsule containing 25.65 mg/g in the form of gallic acid resulted. Moringa seed powder has a total phenolic content of 101.81–460.86 mg gallic acid equivalents/g, which has antioxidant properties. According **[47, 48]**, the carob extract's potent scavenging action on free radicals and reactive oxygen, which contributes to its antioxidant activity in carob pulp **[49, 50]**, WPI antioxidant defenses, increase heart health and cancer prevention, and improve bone health and athletic **[11]**, One excellent source of antioxidants is Moringa oleifera seeds **[51],** Date pits' high flavonoid and other active component content provides antioxidant potency according **[52, 53, 54, 55, 56]**, The highest antioxidant activity is found in the pulp of doum fruits **[18]**, Many studies have proven the effectiveness of taurine as an antioxidant **[57]**.

Table 2: Antioxidant status of dietary ergogenic capsule

Analysis	dietary ergogenic capsule
Total phenols (mg GAE/g)	25.65±1.21
Total flavonoids (mg QUE/g)	17.0±0.01
Total Carotenoids (µg/g)	0.1±0.02
Total Chlorophyll (mg/g)	2.07±1.14
Antioxidant activity (µmole Trolox/g)	116.97±0.13

Data are mean ± SE, n=3

3.3. Polyphenol compounds of Dietary ergogenic capsule by HPLC

The chromatographic analysis of a dietary supplement capsule consists of a mixture of a wide range of important phenolic compounds. From this **Table (3)**, the phenolic compounds detected using HPLC technology can be divided into three categories: upper, middle, and lower values. First, the highest level was found in the case of Benzoic acid (2093.36 mg/kg), Quinol (1126.032 mg/kg), Chlorogenic (1119.66 mg/kg) and Myricetin (257.56 mg/kg). Secondly, the moderate included Quercetin (193.70647 mg/kg), Rutin (146.13 mg/kg), Ellagic (134.9 mg/kg) and Catechol (95.9 mg/kg). Other detected phenolic compounds, including 13 compounds, ranged from 67.01 mg/kg (p- Coumaric acid), 48.21 mg/kg (Gallic acid), 23.625 mg/kg and 11.09 (Ferulic acid). While the thirteenth Caffeic acid compound had the lowest value discovered (3.39 mg/kg). The antioxidant activity of Spirulina platensis was measured at 39.18%. Furthermore, it contained high levels of flavonoids, β-carotene, vitamin E, and phenolics, with respective concentrations of 711, 70, 60, and 997 mg/100g according **[47]**, the total polyphenol (15.8–24.4 mg/g) in Carob pulp according **[45]**, Rich in polyphenolic compounds with significant antioxidant potential are date pits **[58, 59, 60]**, Doum fruits Contains 19:90 mg/g of flavonoids and 7:13 mg/g of total polyphenols as reported by **[61]**.

Table 3: Polyphenol compounds of Dietary ergogenic capsule by HPLC

Polyphenol compounds	Concentration (ppm)
Quinol	1126.03
Catechol	95.88
Chlorogenic	1119.66
Caffeic acid	3.39
p- Coumaric acid	67.01
Benzoic acid	2093.36
Ferulic acid	11.09
Rutin	146.13
Ellagic	134.90
o- Coumaric acid	23.62
Quercitin	193.71
Myricetin	257.56
Gallic acid	48.21

3.4. Amino acid composition of Dietary ergogenic capsule

Data in **Table (4) and Fig. (1)** showed that the dietary ergogenic capsule contained a high amount from essential amino acids (EAAs) and nonessential amino acids (N-EAA). An amino acid is considered essential if an organism cannot synthesize it from nutrients at a rate that meets the requirements of normal growth. In humans, Leucine, isoleucine and valine are three essential branched-chain amino acids (BCAAs). They are not produced by the body and must therefore be absorbed externally. And what's worth noting: BCAAs bypass metabolism in the liver and are oxidized in skeletal muscle. Leucine, specifically, in mammals, activates the target of rapamciyn-1 (mTOR), an anabolic signal that mediates muscle protein synthesis, which in turn is associated with adaptations to strength and inflation. To this end, BCAAs are believed to have positive effects on performance, recovery and body composition. Spirulina is a rich source of protein, with a percentage of 56.79 According **[47]**, Moringa seed is a newly discovered protein source that has a well-balanced composition of amino

acids **[62]**, Total amino acid contents ranged between 3.87 and 8.21% in Carob pulp **[63]**, WPI high-quality protein such as whey contains all the essential amino acids that the body needs on a daily basis **[11]**.

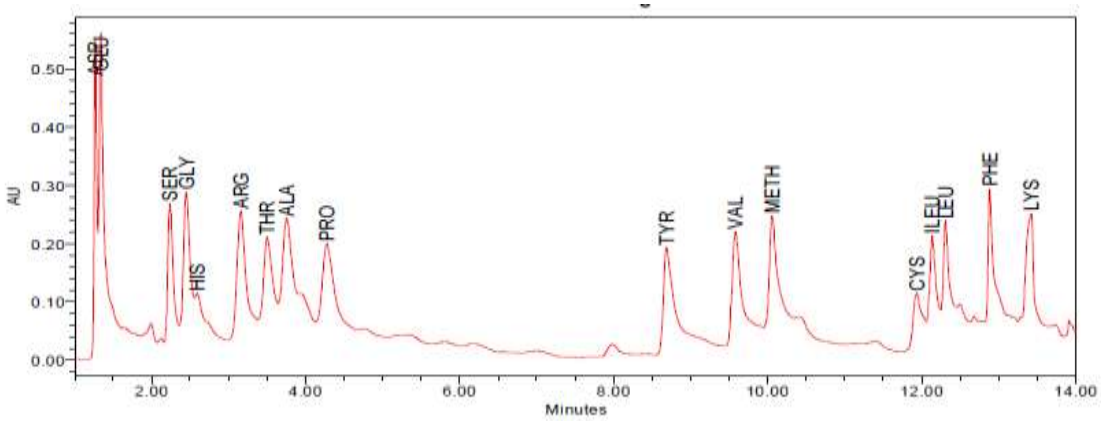

Fig. 1: Chromatogram of amino acid composition of dietary ergogenic capsule

Table 4: Amino acid composition of Dietary ergogenic capsule

Amino Acid (g/ 100 gram protein)	Dietary supplements capsule	FAO/WHO/UNU (1985) pattern
	Essential amino acids (EAA)	
***Leucine**	9.037	6.6
***Isoleucine**	6.829	2.8
***Valine**	5.038	3.5
Methionine	3.447	2.2
Histidine	11.8	1.9
Threonine	11.548	3.4
Phenylalanine	5.681	
Lysine	13.593	5.8
Tryptophan	5.14	1.0
Total (EAA)	72.113	27.2
	Non-Essential amino acids (N-EAA)	
Aspartic acid	22.153	
Glutamic acid	13.558	
Serine	7.124	
Glycine	5.423	
Arginine	48.664	
Alanine	8.739	
Proline	12.929	
Tyrosine	3.753	
Cysteine	1.639	
Total (N-EAA)	123.982	
C-PER	2.83	
BV	79.69	

*Branched Chain Amino Acids; EAA: Essential Amino Acids; N-EAA: Non-Essential Amino Acids C-PER = Computed Protein Efficiency Ratio & BV = Biological Value

3.5. The anthropometric characteristics for weightlifting athletes

Data recorded in **Table (5)** refer to the anthropometric measurement of weightlifting who are the subject of this study. Males show greater weight and length than females. In contrast, there was no discernible difference in the body mass index

parameter between male and female weightlifters. According to this metric, the weightlifters who were the subject of the study showed no signs of obesity.
Additionally, it is reported that male weightlifters waist circumference increased significantly (to78.3 cm) in comparison to female weightlifters' waist circumference (to70.1 cm), the waist-to-hip ratio (0.834) and (0.744) showed a rise in the proportion of male over female. However, there were no appreciable variations in the hip circumference, mid upper arm circumference index measured and waist-to-height ratio. These results are similar with those reported by **[64, 65, 66]**.

Table 5: The anthropometric characteristics for weightlifting athletes

Variables	weightlifting athletes	
	Male (n=11)	Female (n=14)
Weight, kg	67.9^{a} ±4.434	58.4^{a} ±2.342
Height, cm	168.5^{a} ±2.602	157.3^{b} ±2.326
BMI, kg/m^2	23.7^{a} ±1.031	23.6^{a} ±0.800
IBW, %	89.5^{b} ±3.544	114.5^{a} ±4.604
Waist circumference, cm	78.3^{a} ±2.747	70.1^{b} ±1.463
Hip circumference, cm	94.5^{a} ±2.788	94.4^{a} ±1.609
Waist-to-Hip Ratio (WHR), cm	0.834^{a} ±0.017	0.744^{b} ±0.011
Waist-to-Height Ratio (WHtR), cm	0.467^{a} ±0.012	0.447^{a} ±0.010
Mid upper arm circumference index (MUAC), cm	28.8^{a} ±0.952	27.1^{a} ±0.867

Data are mean ± SE, , means with the same letter in the same row are not significantly different P<0.05

3.6. Skinfolds and body composition of weightlifting athletes

Data observed in **Table (6)** indicated that the Weightlifters body composition and four different skin fold measurements (mm) revealed no discernible gender difference in the skinfolds in the triceps, thighs, subscapular, and suprailiac regions. The athlete's body composition indicators, however, indicated that they were within normal bounds.

Table 6: Skinfolds and body composition of weightlifting athletes

Variables	weightlifting athletes	
	Male (n=11)	Female (n=14)
Triceps skinfold thickness, mm	16.0 ^{a} ±1.152	18.8 ^{a} ±1.327
Biceps skinfold thickness, mm	11.4 ^{a} ±1.146	12.3 ^{a} ±0.808
Subscapular skinfold thickness, mm	14.6 ^{a} ±1.155	16.8 ^{a} ±0.956
Suprailiac skinfold thickness, mm	15.0 ^{a} ±1.612	17.6 ^{a} ±0.957
Body fat, %	22.9 ^{b} ±1.078	32.1 ^{a} ±0.563
Fat mass, kg	15.7 ^{a} ±1.488	18.9 ^{a} ±1.066
Lean mass, kg	39.5 ^{b} ±3.262	52.2 ^{a} ±1.317

Data are mean ± SE, means with the same letter in the same row are not significantly different P<0.05

3.7. Effect of Dietary ergogenic capsule on physical performance parameters for weightlifter athletes

Table (7) showed how dietary supplement capsules affected weightlifters' physical performance. A set of exercises was found to enable players to raise their weight above the weights recorded at intervals of 0 and 6 weeks over a period of 6 weeks. In addition to showing a notable increase in male lifter efficiency relative to female lifter efficiency during the experiment period, the weights lifted by each gender were increased during the aforementioned periods **[66]**.

Table 7: Effect of Dietary ergogenic capsule on physical performance parameters for weightlifting athletes

parameter	Weightlifting Athletes	
	Male (n=11)	Female (n=14)
Total snatch and C&J*, kg	198.45^{a} ±18.534	118.50^{b} ±7.325

means with the same letter in the same row are not significantly different P<0.05; * C&J: Clean &Jerk.

4. Conclusion

Based on the results, it could be concluded that the current trends of a healthy lifestyle for health promotion have led to consuming innovative health-beneficial dietary ergogenic products based on natural sources. The high bioactive compounds of the natural dietary ergogenic capsule could be used as a potential source for nutraceutical ingredients to improve the performance and endurance for weightlifting athletes.

Conflict of interest

All authors declare no conflict of interest.

Formatting of funding sources

No competing financial interests exist.

Acknowledgement

There has been no significant financial support for this work that could have influenced its outcome.

5. References

[1]**Diego A. B., Daniel B. and Juan Del Coso (2023).** Advances in Nutrition, Dietary Supplements and Ergogenic Aids for Athletic Performance: Trends and Future Prospects. Nutrients, 15, 2246 Nutrients 2023, 15, 2246.

[2]**Parmod K. S. and Vikarm S. (2023).** Ergogenic aids in relation with Olympic weightlifting sport. International journal of behavioral social and movement sciences (ISSN: 2277-7547).

[3]**Maha A., Nasser A. and Mohammad S. R. (2023).** applications of date pits in foods to enhance their functionality and quality: A review. Frontiers in sustainable food system.10.3389/fsufs.

[4]**Mohammad A., Manisha V., Rojin G. R., Ian O. and Amit S. (2023).** Adaptogenic herbs: A natural way to improve athletic performance. Health Sciences Review; 7:100092.

[5]**Wen C, Li F, Zhang L. (2019).** Taurine is Involved in Energy Metabolism in Muscles, Adipose Tissue, and the Liver. Mol Nutr Food Res. 63(2):e1800536.

[6]**Rutherford J.A., Spriet L.L., Stellingwerff T. (2010).** The effect of acute taurine ingestion on endurance performance and metabolism in well trained cyclists. Int J Sport Nutr Exerc Metab.;20 (4):322–329.

[7]**Zhang M, Qi B and Zhang M. (2004).** Role of taurine supplementation to prevent exercise-induced oxidative stress in healthy young men. Amino Acids.;26(2):203–207.

[8]**Waldron M, Patterson SD, Tallent J. (2018).** The Effects of an Oral Taurine Dose and Supplementation Period on Endurance Exercise Performance in Humans: a Meta-Analysis. Sports Med. 48(5):1247–1253.

[9]**Kholoud K. K., Melanie-Jayne R. H., Robert H., Paul A. S., Iain W. F. and Gladys O.L. (2022).** Cytotoxicity of Fenugreek Sprout and Seed Extracts and Their Bioactive Constituents on MCF-7 Breast Cancer Cells. nutrients Nutrients, 14, 784. https://doi.org/10.3390/nu14040784.

[10]**Manoj K., Pavidharshini S., Swati K., Mrunal D. B., Jos´ e M. L., Vivek S., Jayashree P., Sushil C., Amr E., Samy S., Ali A.S., Radham S. S., Marisennayya S., R. Pandiselvamp, Abhijit D., Sangram D., Suman N., Ryszard A and John F.K. (2022)**. Moringa oleifera Lam. seed proteins: Extraction, preparation of protein hydrolysates, bioactivities, functional food properties, and industrial application. Food Hydrocolloids 131:107791.

[11]**Vildan A., Melisa Ü. and Nayil D. (2024).** The importance and health benefits of whey proteins, journal of hygienic engineering and design, UDC 637.344.045:613.292.

[12]**Ajitha N. K. G. R., Ananthakrishnan J. Nair., Vetha S. S. (2018).** A review on Royal Jelly proteins and peptides. Journal of Functional Foods 44 255–264.

[13]**Abdul M. R., Anosh I., Saira Z., Umar F., Hassan B. U., Sajeela A., Juweria A., Zehra P. and Sehar I. (2023).** Spirulina, an FDA-approved functional food: Worth the hype? Cellular and Molecular Biology., 69(1): 137-144.

[14]**Maryam M., Seyed A. A., Farzad K., Mohammad G.,Maryam K., Shaya Mokhtari and Mahmoud K. (2023).** Wheat germ a byproduct of the wheat milling industry, as a beneficial source of anti- aging olyamines: A quantitative comparison of various forms. Food Sci Nutr. 11:7242–7254.

[15]**David B. Pyne., Nicholas P. West., Amanda J. Cox., and Allan W. Cripps (2014).** Probiotics supplementation for athletes Clinical and physiological effects. European Journal of Sport Science, http://dx.doi.org/10.1080/17461391.2014.971879.

[16]**Tabasum F., Omar B., Bazila N. and Syed Z.H. (2018).** Dandelion: Phytochemistry and clinical potential. Journal of Medicinal Plants Studies 2018; 6(2): 198-202.

[17]**María E. B., Teresa R.S. B., Cristina L.M.S. and Manuela P. (2021).** Carob bean (*Ceratonia siliqua* L.): A new perspective for functional food. Trends in Food Science & Technology 114:310–322.

[18]**Kolla M.C., A. Laya., J.P. Bayang and B.B. Koubala (2021)**. Effect of different drying methods and storage conditions on physical, nutritional, bioactive compounds and antioxidant properties of doum (*Hyphaene thebaica*) fruits, Heliyon 7:e06678, https://doi.org/10.1016/j.heliyon.2021.e06678.

[19]**Saied, A.S., Gebauer, J., Hammer, K., Buerkert, A. (2008).** Ziziphus spina-christi (L.) Willd.: a multipurpose fruit Ziziphus spina Resources and Crop Evolution. 55(7). 929-937. 2008.
[20]**Duke, J.A. (2002).** Handbook of Medicinal Herbs, Second edn: CRC Press.
[21]**Berry-Koch, A., Moench, R., Hakewill, P., Dualeh, M. (1990).** Alleviation of nutritional deficiency diseases in refugees. Food and nutrition bulletin; 12(2):1-7.
[22] **Alhakmani, F., Khan, S.A., Ahmad, A. (2014).** Determination of total phenol, in-vitro antioxidant and anti-inflammatory activity of seeds and fruits of Zizyphus spina-christi grown in Oman. Asian Pacific Journal of Tropical Biomedicine. 4. S656-S660.
[23] **Awah, F.M., Uzoegwu, P.N., Ifeonu, P., Oyugi, J.O., Rutherford, J., Yao, X., Fehrmann, F., Fowke, K.R., Eze, M.O. (2012).** "Free radical scavenging activity, phenolic contents and cytotoxicity of selected Nigerian medicinal plants", Food Chemistry. 131(4). 1279-1286.
[24] **Weidner, S., Powałka, A., Karamać, M., Amarowicz, R. (2012).** Extracts of phenolic compounds from seeds of three wild grapevines Comparison of their antioxidant activities and the content of phenolic compounds. International journal of molecular sciences. 13(3).3444-3457.
[25] **A.O.A.C., (2012).** Official Methods of Analysis of the Association of Official Analytical Chemistry (A.O.A.C.) International**,** 19th ed., Gaithersburg, Maryland, USA.
[26]**Bloor S. (2001)**. Overview of methods for analysis and identification of flavonoids, Methods in Enzymology, 335:3-14.
[27]**Heinrikson R.L. and Meredith SC. (1984)** Amino acid analysis by reverse-phase high-performance liquid chromatography: precolumn derivatization with phenylisothiocyanate. Anal Biochem.; 136(1):65-74.
[28]**White, j. A., Hart, R. J. and Fry J. C. (1986)** An evaluation of the Waters Pico-Tag system for the amino-acid analysis of food materials. Journal of Automatic Chemistry of Clinical Laboratory Automation, Vol. 8, No. 4 (October-December 1986), pp. 170-177.
[29]**Cohen, S. A.; Mewyes, M. and Travin, T. L. (1989)** The Pico-Tag Method. In "A manual of advanced techniques for amino acid analysis", Millipore, USA.
[30]**Miller, E.L. (1967)** Determination of the tryptophan content of feeding stuffs with particular reference to cereals. J. Sci. Food Agric, 18:381-387.
[31]**Alsmeyer, R. H., Cuningham, A.E. and Happich, M.L. (1974)** Equations predict PER from amino acid analysis. Food Techno.; 28(7):34-40.
[32]**Farag, S. A.; El-Shirbeeny, A. and Nassef, A.E. (1996)** Physicochemical studies for preparing quick-cooking rice by using gamma irradiation. Annals of Agric Sci.Moshtohor, 34: 641-652.
[33]**Singleton V.L., Orthofer R., and Lamuela-Raventó´s R.M. (1999)** Analysis of total phenols and other oxidation substrates and antioxidants by means of Folin-Ciocalteu reagent. Methods in Enzymology, 299:152–178.
[34]**Mohdaly A.A.A., Hassanien M.F.R., Mahmoud A., Sarhan M.A. & Smetanska I. (2012)** Phenolics extracted from potato, sugar beet, and sesame processing by-products. International Journal of Food Properties, 16:1148–1168.
[35]**Lichtenthaler, H.K., and A.R. Wellburn (1983)**. Determinations of total carotenoids and chlorophylls a and b of leaf extracts in different solvents. Biochem. Soc. Trans 11:591–592.
[36]**Sumanta, N., C.I. Haque, J. Nishika, and R. Suprakash. (2014)**. Spectrophotometric analysis of chlorophylls and carotenoids from commonly grown fern species by using various extracting solvents. Res. J. Chem. Sci. 2231: p.606X.
[37]**Brand-Williams, W., Cuvelier, M. E. and Berset, C. (1995)** Use of free radical method to evaluate antioxidant activity. Lebensmittel Wissenschaft und Technol. 28:25-30.
[38]**WHO, (2008).** BMI categories. http://www.euro.who.int/ nutrition.
[39]**Lee, C.M.; Huxley, R.R.; Wildman, R.P. and Woodward, M. (2008)** Indices of abdominal obesity are better discriminators of cardiovascular risk factors than BMI: a meta-analysis. J Clin Epidemiol., 61,646–653.
[40]**Whitney, E.; Kelly, D.L.; Pinna, K. and Rady, R.S. (2010)** Nutrition for health and health care. Cengage Learning, 4,394-395**.**
[41]**Jackson A.S. and Pollock M.L. (1978)** Generalized equations for predicting body density of men. British J of Nutrition, 40:497-504.
[42]**Jackson A.S., Pollock M.L. and Ward A. (1980)** Generalized equations for predicting body density of women. Medicine and Science in Sports and Exercise, 12:175-182.
[43]**Steel, R., Torrie, J. and Dickey, D. 1997** Principles and Procedures of Statistics: A Biometrical Approach. 3rd Ed, McGraw-Hill, New York, NY, MSA.
[44]**SAS, 1996. SAS/ Stat Users Guide: Statistics, System for Windows, version 4.10** (release 8.01 TS level 01M0), SAS Inst., Inc. Cary, North Carolina, USA.
[45]**Avallone, R., Plessi, M., Baraldi, M., & Monzani, A. (1997).** Determination of chemical composition of carob (Ceratonia siliqua): Protein, fat, carbohydrates, and tannins. Journal of Food Composition and Analysis, 10(2), 166–172. https://doi.org/10.1006/ jfca.1997.0528.
[46]**Vandita S., Nejib G., Musthafa M. E., Mohamed Sh. R. and Subash S. (2012)** In vitro Antioxidant Activities of Ziziphus spina-christi Fruits (Red Date) Grown in Oman, Biotechnology; 11(4):209-216.
[47]**Sara El-Moataaz, Hanaa Ismael and Samar Abo-Rhyem (2019). Assessment of Chemical Composition of Spirulina Platensis and its Effect on Fasting Blood Glucose and Lipid Profile in Diabetic Rats.** Journal of High Institute of Public Health ,49(3):199-211.
[48]**Sharma, P., Wichaphon, J. and Klangpetch, W. (2020).** Antimicrobial and antioxidant activities of defatted Moringa oleifera seed meal extract obtained by ultrasound- assisted extraction and application as a natural antimicrobial coating for raw chicken sausages. International Journal of Food Microbiology, 332.

[49]**Rtibi, K., Jabri, M. A., Selmi, S., Souli, A., Sebai, H., El-Benna, J., Amri, M., and Marzouki, L. (2015a).** Carob pods (*Ceratonia siliqua* L.) inhibit human neutrophils myeloperoxidase and in vitro ROS-scavenging activity. RSC Advances, 5(102):84207–84215.

[50]**Rtibi, K., Jabri, M. A., Selmi, S., Souli, A., Sebai, H., El-Benna, J., Amri, M., and Marzouki, L. (2015b).** Gastroprotective effect of carob (Ceratonia siliqua L.) against ethanol-induced oxidative stress in rat. BMC Complementary and Alternative Medicine, 15(1):1–8.

[51]**Ezz El-Din I. M., Alqurashi, R.M. and Alfaraj, F.Y. (2022)** Antioxidant Activity of Moringa oleifera and Olive Olea europaea L. Leaf Powders and Extracts on Quality and Oxidation Stability of Chicken Burgers. Antioxidants, 11, 496.

[52]**Besbes, S., Drira, L., Blecker, C., DEroanne, C., and Attia, H. (2009).** Adding value to hard date (Phoenix dactylifera L.): compositional, functional and sensory characteristicsof date jam. Food Chem. 112, 406–411. https://doi: 10.1016/j.foodchem.2008.05.093.

[53]**Habib, H., Othman, A., Al-Marzooqi, S., Al-Bawardi, A., Pathan, J. Y., Hilary, S., (2017).** The antioxidant activity of date seed: preliminary results of a preclinical in vivo study. Emirates J. Food Agric. 22–832. https://doi:10.9755/ejfa.2017.v29.i11.1477.

[54]**Al-Juhaimi, F., Özcan, M. M., Adiamo, O. Q., ALSawmahi, O. N., Ghafoor, K., and Babiker, E. E. (2018).** Effect of date varieties on physico-chemical properties, fatty acid composition, tocopherol contents, and phenolic compounds of some date seed and oils.J. Food Process. Preservat. 42, e13584. https://doi: 10.1111/jfpp.13584.

[55]**Nehdi, I. A., Sbihi, H.M., Tan, C. P., Rashid, U., and AL-Resayes, S. I. (2018).** Chemical composition of date palm (Phoenix dactylifera L.) seed oil from six Saudi Arabian cultivars. J. Food Sci. 83, 624–630, https://doi: 10.1111/1750-3841.14033.

[56]**Metoui,M., Essid, A., Bouzoumita, A., and Ferchichi, A. (2019).** Chemical composition, antioxidant and antibacterial activity of tunisian date palm seed. Polish J. Environ. Stud.28, 267–274. https://doi: 10.15244/pjoes/84918.

[57]**Nadeem, R., Akash, V., Mohd, S., Rizwan, A. and Mohammad, S. (2023).** Taurine, a non-proteinous essential amino acid for human body systems: an overview, Arab Gulf Journal of Scientific Research, 41(1):48-66.

[58]**Al-Farsi, M., Alasalvar, C., Al-Abid, M., Al-Shoaily, K., Al-Amry, M., and Al-Rawahy,F. (2007).** Compositional and functional characteristics of dates, syrups, and their by-products. Food Chem. 104, 943–947. https://doi: 10.1016/j.foodchem. 2006.12.051.

[59]**Al-Oqla, F. M., ALothman, O. Y., Jawaid, M., Sapuan, S., and ES Saheb, M. (2014).** Processing and Properties of date palm fibers and its composites in Biomass and Bioenergy, eds K. Hakeem, M. Jawaid, and U. Rashid (Cham: Springer). https://doi: 10.1007/978-3-319-07641-6_1.

[60]**Radfar, R., Farhoodi, M., Ghasemi, I., Khaneghah, A. M., Shahraz, F., and Hosseini, H. (2019).** Assessment of phenolic contents and antioxidant and antibacterial activities of extracts from four varieties of Iranian date Palm (*Phoenix dactylifera* L.) seeds. Appl. Food Biotechnol.; 6:173–184. https://doi: 10.22037/afb. v6i3.23379.

[61]**Atito, E., Moustafa, M.F., Siddiqui, S., El-Sayed, M. (2019).** Antioxidant, anti-α-amylase and antimicrobial activities of doum (*Hyphaene thebaica*) and argun (Medemia argun) fruit parts. Int. J. Pharmacol. 15 (8), 953–961.

[62]**Ogunyemi T.C., Ikhuoria E.U., Olaofe O. and Ogunyemi, S.T. (2019).** Amino acid composition and proximate analysis of moringa oleifera seed grown in south-western Nigeria. Technical Transactions of Materials Science and Technology Society of Nigeria, 2, 88–95.

[63]**Khlifa, M., Bahloul, A., and Kitane, S. (2013).** Determination of chemical composition of carob pod (Ceratonia siliqua L) and its morphological study. Journal of Materials and Environmental Science, 4(3), 348–353.

[64]**Keogh, J. W. L., Hume, P. A., Pearson, S. N., and Mellow, P. (2008).** To what extent does sexual dimorphism exist in competitive powerlifters? Journal of Sports Sciences, 26(5):531–541, https://doi:10.1080/02640410701644034.

[65]**Pekel, H. A., Bağcı, E., Güzel, N. A., Onay, M., Balcı, Ş. S., and Pepe, H. (2006).** The evaluation reliationship between some anthropometric characteristics and performance-related physical fitness test result in childeren athletes. Kastamonu Education Journal, 14(1);299-308.

[66]**Kenan E., Osman T., Mustafa Y., Raif Ö., Mehmet B. and Eyyüp M.D. (2020).** The Examination of Relationship Between Anthropometric Measurement Values of Lower Extremity and Weightlifting Performance of Olympic Style Weightlifting Athletes. Türkiye Spor Bilimleri Dergisi. 4(1);1-8, https://DOI: 10.32706/tusbid.702777.