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EFFECT OF SHORT-TERM CONSUMPTION BITTER APRICOT SEEDS ON THE BODY COMPOSITION IN HEALTHY POPULATION

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ABSTRACT

The distribution of fat in different areas of the body is important since accumulation of fat within the abdominal cavity represents a much more severe cardiovascular risk than accumulation in subcutaneous adipose tissues. Apricot seeds contain a wide variety of bioactive compounds and that consumption can decrease blood pressure and total blood cholesterol levels, fight oxidative stress and maintain body weight. The aim of the study was to analyse body composition: body fat mass (BFM), fat free mass (FFM), skeletal muscle mass (SMM), body fat percentage (%BFM), visceral fat area (VFA), total body water (TBW) – intracellular water (ICW) and extracellular water (ECW) and to evaluate the changes that occur after 6-weeks consumption of bitter apricot seeds. The study group finally consisted of 34 healthy adults volunteers (21 females and 13 males). Volunteers were recruited from the general population of Slovakia. Respondents were 23 – 65 years old, where the average age of women was 40.65 ±11.31 years and the average age of men was 36.91 ±9.98 years. All participants were asked to consume 60 $mg.kg^{-1}$ of body weight of bitter apricot seeds daily during 6 weeks. Body composition was diagnosed by multi-frequency bioelectrical impedance analysis (MFBIA) by InBody 720 (Biospace Co., Korea), which measures the total impedance at frequencies of 1, 5, 50, 100, 500, 1000 kHz. At baseline mean body weight was 85.78 ±14.66 and 62.84 ±12.19 kg in the male and female participants, respectively. After 6 weeks of consumation we observed non-significant decreasing of mean body weight. The mean BFM was 19.25 ±8.81 kg in the male group and 19.47 ±7.21 kg in the female group. After six weeks, BFM decreased non-significantly (on average 0.5 kg) in both groups. The mean FFM at baseline was 43.37 ±5.98 and 66.54 ±7.98 kg in the female and male participants, respectively. The statistical analysis confirmed that the increase of FFM (43.37 ±5.98 kg to 43.56 ±5.80 kg) in the female were statistically significant (p <0.05). VFA was greater in the men (82.04 ±39.82 cm^2 at baseline and 78.65 ±39.79 cm^2 after 6 weeks) comparison to women (79.82 ±29.03 cm^2 at baseline and 78.29 ±29.90 cm^2 after 6 weeks). The mean of TBW in males before the start of study was 48.78 ±5.77 kg and 47.88 ±5.57 kg after 6 weeks of consumption. The results of study show the small weight loss in the both group. Therefore, the results from this study indicate that daily consumption of bitter apricot seeds produce measurable health benefits, but further studies are also required.

Keywords: cardiovascular diseases; bitter apricot seeds; body fat; visceral adipose tissue; bioelectrical impedance

INTRODUCTION

The incidence of cardiovascular diseases (CVD) is rapidly increasing worldwide and is currently considered to be the leading cause of death in both developing and developed countries **(Gaziano et al., 2010; Mittal et al., 2010)**. In Europe, cardiovascular diseases are responsible for 43% of deaths in men and 55% in women and for 30% of all deaths before the age of 65 years. Eighty percent of cardiovascular accidents could probably be avoided by lifestyle adjustment (weight control, smoking abstinence, physical activity, and a healthy diet), together with proper management of clinical and biological risk factors **(Carpentier and Komsa-Penkova, 2011)**. There is a growing interest of natural products in human diet, both due to the possible negative effects of synthetic food additives on human health and to the increased consumer perception of this problem in recent years **(Yurt and Celik, 2011)**. In addition, a great number of spices and aromatic herbs contain chemical compounds exhibiting antioxidant properties. These properties are attributed to a variety of active phytochemicals including vitamins, carotenoids, terpenoids, alkaloids, flavonoids, lignans, simple phenols and phenolic acids, and so on **(Liu and Ng, 2000)**. Apricot seeds contain a wide variety of bioactive compounds and that consumption of apricot seeds has been associated with a reduced risk of chronic diseases **(Zhang et al., 2011)**. Diet rich in these compounds can decrease blood pressure and total blood cholesterol levels, fight oxidative stress and maintain body weight **(Turan et al., 2007)**. **Subhashinee et al. (2006)** evaluated the antioxidant properties of apricot seeds by several chemical and biochemical assays. The apricot fruit is a member of the *Rosaceae* family and planted commercially throughout Eurasia and America **(Lim, 2012)**. The fruit seeds of apricot trees are classified according to their taste into sweet apricot, semi-bitter apricot and bitter apricot **(Lee et al., 2013)**. Bitter apricot seeds have long been used in Chinese traditional medicine for the treatment of asthma, bronchitis, emphysema, constipation, nausea, leprosy, leucoderma and pain **(Bensky et al., 2004)**. In addition, bitter apricot seeds have been used for treating several skin diseases, and these include furuncle, acne vulgaris, dandruff and several others **(Lee et al., 2014)**. The use of apricot seeds for human nutrition is limited because of their content of the toxic, cyanogenic glycoside amygdalin, accompanied by minor amounts of prunasin **(Gomez et al., 1998)**. Bitter apricot seeds have high contents of amygdalin (equivalent total cyanide content up to 4000 $mg.kg^{-1}$ **(Zöllner and Giebelmann, 2007)**. Obesity has been increasing in epidemic proportions in both adults and children over many decades, and recently, the proportion of the population with more severe, or morbid obesity has increased to a greater extent than has overweight and mild obesity **(Sturm, 2007)**. Obesity and obesity-related disorders are a major health problem worldwide **(Charakida et al., 2012)**. Each of these disorders, in addition to established vascular risk factors (dyslipidaemia, smoking and hypertension) increases the risk of cardiovascular and other metabolic diseases **(Brunzell et al., 2008)**. The distribution of fat in different areas of the body is important since accumulation of fat within the abdominal cavity represents a much more severe cardiovascular risk than accumulation in subcutaneous adipose tissues **(Poirier et al., 2006)**. The Body Mass Index (BMI) is a basic indicator enabling us to classify obesity and associated risks. When the BMI value exceeds 30 $kg.m^{-2}$, the person is regarded to be obese. The evaluation of obesity by means of BMI as inadequate because this index does not allow for involving the variability and changes in the proportions of fat free mass (FFM) and body fat mass (BFM) **(Gába et al., 2009; Koycu et al., 2016)**. Therefore, the purpose of the study was to analyse body composition: body fat mass (BFM), fat free mass (FFM), skeletal muscle mass (SMM), body fat percentage (% BFM), visceral fat area (VFA), total body water (TBW) – intracellular water (ICW) and extracellular water (ECW) and to evaluate the changes that occur after 6-weeks consumption of bitter apricot seeds.

MATERIAL AND METHODOLOGY

Participants and study design

The study group finally consisted of 34 healthy adult volunteers (21 females and 13 males). Volunteers were recruited from the general population of Slovakia. Respondents were 23 – 65 years old, where the average age of women was 40.65 ±11.31 years and the average age of men was 36.91 ±9.98 years. A written informed consent to participate in the study was provided to all subjects involved in the study after they were informed of all risks, discomforts and benefits. The study was performed from September to December 2015. The trial was approved by the Ethic Committee at the Specialized Hospital St. Zoerardus Zobor, n. o., protocol number 030809/2015.

Intervention

All participants were asked to consume 60 $mg.kg^{-1}$ of body weight of bitter apricot seeds (TRASCO, Žiar nad Hronom, Slovakia) daily during 6 week period. Volunteers were instructed as follows: not to change their usual diet, to consume approximately one seed each hour, seeds had to be chewed as thoroughly as possible, after each consumption drink a lot of water. Subject were measured in the morning after 12-h fasting at baseline, week 3 and 6. Hence, each individual was a sample unit for a paired study before and after the intervention. There was no overall separate control group because as a paired study, the baseline values of the participants served as their own control.

Anthropometric measurement

Body composition was diagnosed by multi-frequency bioelectrical impedance analysis (MFBIA) by InBody 720 (Biospace Co., Korea), which measures the total impedance at frequencies of 1, 5, 50, 100, 500, 1000 kHz and device that differentiates body weight into 3 components – total body water (intracellular and extra cellular), dry mass (proteins and minerals) and body fat.

Total body impedance values were calculated by summing the segmental impedance values that were analysed separately with a tetrapolar eight-point tactile electrode system. Body height was measured on the outpatient electronical medical scales Tanita WB-300 in the standing upright position, without shoes. The measurement was performed under laboratory conditions according to user manual instructions (Biospace, 2008). The procedure took approximately 2 minutes (research mode was activated) and it required no specific skills. Before the measurements were taken, the participant's identification number, name and surname, body height, age and sex were entered into the manufacturer's software, Lookin' Body, version 3.0 (Biospace Co., Ltd.; Seoul, Korea). If possible, the subjects were asked to fast for 2 h, to avoid any vigorous physical activity for at least 48 h before the procedure. Visceral adipose tissue was represented by the visceral fat area (VFA; cm^2), which was defined as a cross-sectional area of visceral fat in the abdomen at the umbilical level. Visceral fat is defined by the cross sectional area of the abdomen at the level of L4-L5. The correlation between the Computer Tomography and InBody 720 is set at r = 0.92. The obtained data were adequately processed by Lookin' Body 3.0, ActiPA 2006 software.

Statistical analyses

The results were evaluated with appropriate standard mathematical-statistical methods and were listed in the tables. We used the program STATISTICA Cz version 10 belonging to the available statistical programs and MS Excel 2007.

All data were expressed as the mean ±standard deviation (SD), and differences between control were determined using Pared Student *t*-test. Differences from control at $p < 0.05$ were considered as significant.

RESULTS AND DISCUSSION

The mean age of the study sample was 40.65 ±11.31 years of women and the mean age of men was 36.91 ±9.98 years. Body weight and height are the simplest, most accessible measurements of body size and are generally reliable with small technical errors of measurements. Thus, they have become important and extensively used epidemiological research tools. However, it is clear they cannot provide information on body composition **(Williams et al., 1997)**. The mean body height of the women was 164.81 ±5.62 cm and 177.00 ±5.82 cm of men. At baseline mean body weight was 85.78 ±14.66 and 62.84 ±12.19 kg in the male and female participants, respectively. At week 6 we observed non-significant decreasing of mean body weight (Table 1, 2).

Although the amount of BFM is caused by genetic factors **(Böttcher et al., 2012)**, it is influenced by non-genetic factors, such as physical inactivity **(Pelclová et al., 2012)** combined with an increased intake of energy-dense foods that are high in lipids or carbohydrates. The amount of BFM usually increases throughout the lifespan. The standard BFM is 15% for males and 23% for females, which are the respective midpoints of the standard ranges of body fat mass in relation to standard weight: 10 – 20% of the standard weight for males and 18 – 28% for females.

The mean BFM was 19.25 ±8.81 kg in the male group and 19.47 ±7.21 kg in the female group. After six weeks, BFM decreased non-significantly (on average 0.5 kg) in both groups. Fifty percent of men had % BFM greater than 20.00% (range 10.00 – 20.00%). More than 70% of women had % BFM greater than 28.00% (range 18.00 – 28.00) and we found statistically significant decrease in % BFM (30.26 ±5.92 to 29.36 ±6.09) (p <0.05). According to **Heyward and Wagner (2004)** the optimal percentage of body fat in the male population older than 55 is 10 – 16%, respectively 25 – 35% in women.

FFM usually increases as humans grow, remains relatively stable throughout maturity and declines during senescence. Generally, FFM peaks between the fourth and fifth decades of life **(Borrud et al., 2010)**, occasionally earlier, and then declines slightly. The decrease in FFM primarily occurs as a result of losses in muscle mass, component of FFM, and is considered the most constant marker of aging. Moreover, the decline in muscle strength caused by the loss of muscle mass contributes to the decline in physical function, as well as increasing disability, frailty and loss of independence **(Taaffe, 2006)**.

The mean FFM at baseline was 43.37 ±5.98 and 66.54 ±7.98 kg in the female and male participants, respectively. The statistical analysis confirmed that the increase in FFM (43.37 ±5.98 kg to 43.56 ±5.80 kg) in the female were statistically significant (p <0.05).

Visceral adipose tissue (VAT) has been cross-sectionally associated with cardiovascular disease and cancer **(Mahabadi et al., 2009)** and is correlated with smaller ectopic fat depots, including pericardial and periaortic fat, which surround the cardiovascular system and may exert local toxic effects **(Greenstein et al., 2009)**. In contrast to prior studies of BMI and waist circumference, visceral adiposity modestly improved CVD risk prediction **(Britton et al., 2013)**. We observed non-significantly reduction of total visceral fat, expressed by VFA (cm^2) in both groups. VFA was higher in the men (82.04 ±39.82 cm^2 at baseline and 78.65 ±39.79 cm^2 at

Table 1 Changes in body composition of women after consumption of bitter apricot seeds.

Parameter	week 0			week 6			P
	mean ±SD	min	max	mean ±SD	min	max	
BW (kg)	62.84 ±12.19	45.80	104.10	62.38 ±12.23	45.40	105.90	0.9223
BFM (kg)	19.47 ±7.21	9.50	42.10	18.82 ±7.40	9.60	43.30	0.1575
BFM (%)	30.26 ±5.92	20.43	40.63	29.36 ±6.09	18.75	40.88	0.0546
FFM (kg)	43.37 ±5.98	36.30	62.00	43.56 ±5.80	35.80	62.60	0.0391
VFA (cm^2)	79.82 ±29.03	42.89	170.25	78.29 ±29.90	42.91	176.56	0.6374
SMM (kg)	23.66 ±3.55	19.41	34.60	23.77 ±3.46	19.19	35.01	0.0318
TBW (kg)	31.77 ±4.36	26.80	45.40	31.94 ±4.23	26.40	45.90	0.0309
ICW (kg)	19.68 ±2.73	16.40	28.10	19.76 ±2.65	16.20	28.40	0.0350
ECW (kg)	12.09 ±1.64	10.40	17.30	12.18 ±1.59	10.20	17.50	0.0515

Note: Each value represents the Mean ±SD.
Pared Student t-test between 0 week and after the 6-week.

Table 2 Changes in body composition of men after consumption of bitter apricot seeds.

Parameter	week 0			week 6			P
	mean ±SD	min	max	mean ±SD	min	max	
BW (kg)	85.78 ±14.66	64.30	109.8	83.88 ±13.78	64.4	110.70	0.7303
BFM (kg)	19.25 ±8.81	6.30	33.10	18.60 ±8.95	6.5	35.30	0.2495
BFM (%)	21.60 ±7.25	9.79	36.21	21.33 ±7.66	10.05	38.05	0.2539
FFM (kg)	66.54 ±7.98	53.20	79.60	65.28 ±7.66	52.4	77.90	0.1830
VFA (cm^2)	82.04 ±39.82	22.03	144.13	78.65 ±39.79	23.49	154.42	0.2803
SMM (kg)	37.40 ±4.88	29.29	46.17	37.22 ±4.70	29.4	45.09	0.1417
TBW (kg)	48.78 ±5.77	39.10	58.10	47.88 ±5.57	38.5	57.10	0.2051
ICW (kg)	30.70 ±3.74	24.50	36.90	30.08 ±3.59	24.1	36.10	0.1298
ECW (kg)	18.10 ±2.05	14.60	21.20	17.80 ±2.01	14.4	21.30	0.3759

Note: Each value represents the Mean ±SD.
Pared Student t-test between 0 week and after the 6-week.

after 6 weeks) comparison to women (79.82 ±29.03 cm^2 at baseline and 78.29 ±29.90 cm^2 at the end). Regardless of general obesity, abdominal obesity and excess visceral fat have been identified as independent risk factors for cardiovascular diseases **(DeLorenzo et al., 2007; Hamdy, 2005; Wisse, 2004)**.

Intracellular water (ICW) indicates the amount of water within the cellular membrane. Extracellular water (ECW) indicates the total amount of water in the interstitial fluid and blood.

The mean of TBW in males before the start of study was 48.78 ±5.77 kg and 47.88 ±5.57 kg after 6 weeks of consumption. ECW and ICW decreased non-significantly (extracellular: 18.10 ±2.05 kg vs.17.80 ±2.01 kg; intracellular: 30.70 ±3.74 kg vs. 30.08 ±3.59 kg). In the group of women, we found significant increase in all parameters: TBW (31.77 ±4.36 vs. 31.94 ±4.23), ECW (12.09 ±1.64 vs. 12.18 ±1.59), ICW (19.68 ±2.73 vs. 19.76 ±2.65) (p <0.05). The benefits and importance of an appropriate hydration for health and performance are well known with total body water (TBW) being comprised of both intracellular (ICW) and extracellular (ECW) with a flux existing between the two **(Matias et al., 2016)**.

CONCLUSION

The current study was limited in a number of ways that deserve careful attention: for example, the study population was relatively small, and this could be the main reason why significant differences for many of the parameters assessed in this study were not detected. The results of study show the small weight loss in the both group. Therefore, the results from this study indicate that daily consumption of bitter apricot seeds produce measurable health benefits, but further studies are also required.

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