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Research Article

The effect of anthocyanin supplementation on systolic and diastolic blood pressure and mean arterial pressure in athletes

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Abstract

Introduction: Anthocyanin has cardio-protective roles, and anti-inflammatory effects. Exercise can play effective roles in this area. We assessed the effects of anthocyanin supplements on blood pressure and mean arterial pressure in combination with exercise.

Methods: This randomized double-blind clinical trial conducted on 54 athletes. Participants in intervention group were taken 100 mg anthocyanin supplements, daily for 6 weeks and control group received similar placebo. Systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean arterial pressure (MAP) were determined before and after performing treadmill test. Data analyzed using analysis of covariance (ANCOVA) test by using SPSS software (version 21.0). Pvalue<0.05 was set as significant level.

Results: SBP is similar between two groups before intervention while its mean value increased after performing treadmill test. SBP and DBP increase was not affected by taking treatments after exercise. SBP increase was higher in placebo group in compare to anthocyanin group, after exercising. MAP was not different before and after taking pills, significantly.

Conclusion: Anthocyanin supplements did not affect SBP, DBP and MAP after performing treadmill exercises in non-professional athletes, significantly. Exercise causes a significant increase in MAP values, while this enhancing did not show a significant difference between two groups.

Keywords: anthocyanin; blood pressure; arterial pressure

Introduction

Flavonoids including a wide range of polyphenolic compounds which based on their structural difference can divided into different derivatives and polyphenols[1]. Polyphenols represent a multi-factorial roles in biological activities, oxidant–scavenging process, and lowering platelet aggregation [2]. Anthocyanin as a major member of this category can be found in high amounts in several kinds of fruits, vegetables, and herbal sources such as cherry, strawberry, raspberry, barberry, blueberry and raisins [1]. The cardioprotective roles, and anti-inflammatory effects of these critical food components show protective [3-10] or not supporting effects [11-14].Its important effects in lowering risk of all-causes of mortality, especially those which is related to coronary heart disease (CHD), and various cardiovascular disorders (CVD) is reflected in a 16 year follow-up study [14]. A number of studies explain the efficacy of different plant sources in lowering CVD biomarkers in short-term intervention trials on healthy participants[1]. Procyanidin oligomers and anthocyanin compounds of plant-source foods can contribute in their putative heart benefits [15,16]. The antioxidant properties of these flavonoids may inhibit the oxidative conversion of nitric oxide (NO) to peroxynitrite in the endothelium surface of vasculars[17]. Moreover, it can decrease production of oxidant-induced peroxynitrite[18] and increase NO synthase (NOS) and its dependent vasorelaxation effects [19]. The effect of flavanol-rich food sources in healthy adults can be accompanied with increasing vasorelaxation[20], and improving flow-mediated dilation (FMD) in arteries [21]. So, it may have

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preventive role in vasorelaxation impairment and dysregulation of blood pressure (BP) [22]. However, enhancing endothelial NOS expression and its bioavailability can ameliorate endothelial disorder, which can potentially lead to lower blood pressure (BP), and slowing down the atherogenetic processes. Anthocyanin cyanidin-3-glucoside can increase the process of NOS expression and its active bioavailability in vascular endothelial cells [23]. The lowering BP role is observed in healthy volunteers, after 15 days of intervention, previously [24]. Verifying anthocyanin supplements effects in controlling systolic and diastolic blood pressure can reflect a helpful remedy for nursing care recommendations. Thus, in the present trial, we tried to evaluate the effects of anthocyanin supplements in athletes and to assess its effects on different blood pressure values in routine status and in comparison to its mean after aerobic exercises.

Methods

This is a randomized double-blind clinical trial including 54 athletes of Isfahan University of Medical Sciences (IUMS). Ethical Committee of Isfahan University of Medical Sciences approved performing of this clinical trial and after explaining the aim and process of this trial, written consents were taken from all of the participants. Inclusion criteria were defined as having a history of exercise for at least 3 years. However, subjects who had taken any drugs or antioxidant supplements over the previous months were extracted from the study. In addition, subjects who followed lower than 70% of trial procedure or having history of any chronic or metabolic diseases were excluded. Sample size of the present study was calculated using following formula: $\frac{\left(Z_{1-\frac{\alpha}{2}}+Z_{1-\beta}\right)^{2}(S_1^2+S_2^2)}{d^2}$, (α=0.05, β=0.2) and d=0.25.

Participants were divided into two groups, by a person who was not aware of our study aims. Random permuted block method had been used to assign subjects in intervention or control groups. First group was taken a 100 milligram anthocyanin pill, daily for 6 weeks, while control group received a 100 milligram placebo pills. It should be mentioned that color, odor, shape and taste of placebo pills were nearly similar to the anthocyanin pills and we used lactose as their filler content. Participants followed their common diet and physical activity program during the study. We used phone calls or text messages to mention taking supplements. At endpoint of the intervention period, numbers of remained pills were assessed to control the participants' adherence from trial guideline. Subjects' systolic and diastolic blood pressures were measured at baseline and after the intervention. Before measurements of systolic and diastolic blood pressure values, participants asked to rest for approximately 20 minutes, and then all of the assessments were performed by an expert physician at a seated position. Each measurement was done twice and averages of the mentioned amounts were defined as BP values. General practitioner used a calibrated mercury sphygmomanometer, and SPB was determined as the presence of the first sound (the first phase of Korotkoff), and DBP was assessed by the disappearance of the mentioned sound (the fifth phase of Korotkoff). Measurements were done during cuff collapsing at a rate of 2-3 mmHg/s of the mercury column. Mean arterial pressure (MAR) of participants were calculated by the following formula:1/3 SBP (mmHg)+2/3 DBP(mmHg). In addition, all of the mentioned variables were evaluated both before and after exercising on treadmill at baseline and after intervention period.

Quantitative data are presented in mean and standard deviation (mean ± SD) and qualitative data are shown in frequency and its' present. The comparison of these data before and after intervention period had been analyzed using paired t-test and quantitative values were assessed using analysis of covariance (ANCOVA), too. The effects of confounding variables had been adjusted in ANCOVA. Data had been analyzed using SPSS software (version 18.0). Significant level was determined as probability value lower than 0.05.

Results

In this double blind clinical trial 54 individuals (24 women and 30 men) had been assigned. Five participants did not follow 70% of our procedure because of gastrointestinal complaints or unwilling to continue the study. Participants' characteristics are shown in Table 1.

The average of systolic blood pressure was similar between two groups before intervention while its mean values increased after performing treadmill test. This increase had been observed even after intervention period. However, elevating SBP was not significantly different between intervention and control groups Table 2.

Table1: Participants' characteristics between intervention and control groups.

Variables	Intervention group	Placebo group	Pvalue
SBP (mmHg)			
Before exercise	111.05±11.97	138.50±14.96	<0.001
After exercise	111.58±11.19	136.50±14.24	-
Pvalue	0.77	0.29	
DBP (mmHg)			
Before exercise	75.79±9.01	73.00±10.31	0.07
After exercise	75.78±7.69	72.50±8.50	-
Pvalue	0.99	0.77	
MAP			
Before exercise	87.54±9.01	94.83±9.52	0.002
After exercise	87.72±8.24	93.83±7.96	-
Pvalue	0.91	0.39	

Table 2: Results of within and between groups comparison in both genders

	Variables		Anthocyanin group			Control group			P-value
			Before Intervention	After Intervention	P-value	Before Intervention	After Intervention	P-value	
Total	SBP (mmHg)	Before exercise	120 ± 6.66	119 ± 3.16		119.09 ± 7.01	119.09 ± 8.31	0.09	
		After exercise	127 ± 41.48	139 ± 9.94	0.26	138.18 ±16.01	136.36 ±13.61	0.09	NS
		Pvalue	0.26	0.26		0.09	0.09	0.09	
	DBP (mmHg)	Before exercise	83 ± 4.83	80 ± 6.66		80.90 ± 3.01	80 ± 4.47		
		After exercise	79 ± 7.37	77 ± 8.23		80 ± 6.32	78.18 ± 6.03		
		Pvalue	0.26						
	MAR	Before exercise	95.33 ± 3.91	93 ± 5.07		93.63 ± 3.78	93.03 ± 5.46		
		After exercise	95.13 ± 14.80	97.66±6.67		99.39 ± 8.01	97.57 ± 7.16		
		Pvalue							
Men	SBP (mmHg)	Before exercise	120 ± 6.66	119 ± 3.16		119.09 ± 7.01	119.09 ± 8.31	0.09	
		After exercise	127 ± 41.48	139 ± 9.94	0.26	138.18 ±16.01	136.36 ±13.61	0.09	NS
		Pvalue	0.26	0.26		0.09	0.09	0.09	
	DBP (mmHg)	Before exercise	83 ± 4.83	80 ± 6.66		80.90 ± 3.01	80 ± 4.47		
		After exercise	79 ± 7.37	77 ± 8.23		80 ± 6.32	78.18 ± 6.03		
		Pvalue	0.26						
	MAR	Before exercise	95.33 ± 3.91	93 ± 5.07		93.63 ± 3.78	93.03 ± 5.46		
		After exercise	95.13 ± 14.80	97.66±6.67		99.39 ± 8.01	97.57 ± 7.16		
		Pvalue							
Women	SBP (mmHg)	Before exercise	101.11 ± 7.81	103.33 ± 2.7		105.55 ± 8.82	106.66 ± 8.69		
		After exercise	134.44±13.33	134.44 ± 7.26	0.08	138.88 ±14.52	136.66 ±15.81	0.23	NS
		Pvalue							
	DBP (mmHg)	Before exercise	67.77 ± 4.41	71.11 ± 6.01		68.88 ± 7.81	70 ± 7.07		
		After exercise	67.77 ± 4.41	67.77 ± 6.66		64.44 ± 7.26	65.55 ± 5.27		
		Pvalue							
	MAR	Before exercise	78.88 ± 2.35	81.85 ± 7.09		81.11 ± 7.45	82.22 ± 6.87		
		After exercise	90 ± 5.27	90 ± 5.52		89.25 ± 8.46	89.25 ± 6.62		
		Pvalue							

The comparison between DBP amounts reflect that its amounts were approximately the same before exercising and its differences after passing intervention period did not increased statistically significant. It should be mentioned that systolic and diastolic blood pressure increase after going on treadmill was not influenced by taking any of the treatment group significantly. However, SBP increase after exercising was higher in placebo group in comparison to the individuals who give anthocyanin supplements. Moreover, MAP was not statistically different before and after taking remedies. Data shows that performing the mentioned exercise causes a significant increase in MAP values in both groups, while this enhancing did not show a significant difference between intervention and control groups.

Discussion

The effect of anthocyanin supplements in comparison with the control group reflect no statistically different in increasing SBP, DBP and MAP, after performing Bruce treadmill exercise test. In the other word, increasing SBP and MAP of subjects after passing the test were not affected by taking supplements or placebo pills, significantly. We analyzed our data in an intention to treat method, while these non-significant changes between the averages of blood pressure values in comparison to the mentioned groups can be influenced by modifying SBP increase in intervention group after exercise and taking supplements, and it may be the reflection of individuals' difference. In addition, routine exercise program of these healthy and athletic students for more than 3 years can cause that the basic effect of these antioxidant supplements had been masked. The usefulness of dietary antioxidant supplements in managing blood pressure values is under debate in several studies. The appropriate dose of anthocyanin supplements had been defined in the range of 100-335 milligram per day for every 70 kilogram individuals [25], and choosing minimum amount in the present trial can explain its non-significant effects. Findings of our study is as the same as previous observations. Qin et al, in a randomized clinical trial on 120 dyslipidemic participants, using 160 mg anthocyanin dose in two times per day for 3 months did not observed reduction of SBP and DBP values [26]. In other long-term trial on hypercholestrolemic subjects, similar dose of these antioxidant supplements cannot lead to a significant decrease in average of SBP and DBP, too [27]. The effect of strawberry powder supplements as a rich source of anthocyanin had been accompanied with a little BP decrease [28]. However, in contrast to the mentioned findings, Erlund et al, observed a significant reduction of BP in healthy individuals [29]. Broncel et al, obtained the same results in study on 22 healthy subjects and 25 patients with metabolic syndrome who were treated in a 2 months trial with anthocyanin content from Aroniamelanocarpa [30]. The effect of pomegranate juice (contain 1.5 millimolar of polyphenols) reflect a reductive effect on activity of angiotensin II converting enzyme (ACE), while these role were not significant on blood pressure values of hypertensive individuals [31] and its effects on thickness of carotid intima media was significant in severe carotid artery stenosis of old patients [32]. Anthocyanin supplements can improve endothelium-dependent vasodilation and these functions are mediated by stimulating nitric oxide pathway which is dependent to the cyclic GMP signaling. Also, these lowering relationships can be influenced by lowering inflammatory marker levels [27]. It should be mentioned that low anthocyanin bioavailability and its wide conjunction and metabolism pathway [33], in addition to the existence of intact anthocyanin in serum level can ameliorate its healthful ability [34, 35]. It seems that more study is needed to confirm the protective effects of anthocyanin supplements in controlling blood pressure in athletic individuals and its recommendation by members of medical team and as a useful remedy in managing blood pressure and protecting its irreversible outcomes in nursing care need much more study, especially in athletes or subjects with history of exercise programs.

The present study has several limitations. First, low dosage of our anthocyanin supplements and small number of the participants can effect on these relationships. Moreover, I should be pointed out that short time intervention period exert various effects. However, the main strength of our clinical trial is using a double blind design. Taking placebo pills in the same order, appearance and taste as anthocyanin pills.

Anthocyanin supplementation efficacy in ameliorating blood pressure amounts is under debate and its lowering blood pressure effects can be performed by reflecting its antioxidant function. Although, it concluded that taking anthocyanin supplements does not affect SBP and DBP amounts and MAP values before and after exercise in athletes. Long-term intervention follow-up in various anthocyanin doses is suggested to evaluate its main effects in individuals with different health status.

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Conflict of Interest

"None."

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