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Effects of Dietary Inclusion of Cornelian Cherry (*Cornus mas L.*) Fruit on Body Weight, Insulin Level and Glycemic Status of Hamsters

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Abstract: The aim of present experiment was to investigate the effect of dietary supplemented CCF on body weight, serum glucose and insulin in healthy condition. In present experiment, 36 one-month-old male hamsters (94±1 g) were divided into four groups; group 1 (control): fed basal diets without fruit supplementation, group 2: fed daily 5 g CCF only at first daily meal, group 3: fed daily 10 g CCF, at first and second daily meals and group 4: fed daily 15 g CCF, at first, second and third daily meals, for 20 days. Dietary CCF caused significant decreases in final body weight. Based on serum biochemical analysis, a significant glucose decrease in groups fed only one supplemented meal and it's correlated with elevation of insulin level. Supplementation of CCF (two or three times daily) was not efficient for more hypoglycemic effect and there was no significant difference with glucose level of control group. Also, there was no any difference between insulin levels of group 2 and 3, whereas there was considerable elevation in insulin level for groups fed CCF in comparison with control rate. It was concluded that supplemented cornelian cherry fruit for one, two or three daily meal can decreases weight gain and for only one daily meal can cause considerable hypoglycemic effect, whereas supplemented for two or three times daily was not more efficient that may be due to glycemic regulation of healthy animals.

Key words: Cornelian cherry fruit, glycemic status, insulin, Syrian hamster

INTRODUCTION

Hyperglycemia is a biomarker for diabetes and diabetic complications (Brownlee, 2001). Currently, Sujatha and Shalin (2012) had published a systematic review that shows potential of herbal drugs for treatment of hyperglycemia and control of diabetes, more efficient than some chemical drugs. A biochemical study on enzymes involved in glucose metabolism show that herbal product such as *Terminalia* species affects α-glucosidase activity as an inhibitor (Anam *et al*., 2009). The cornelian cherry (*Cornus mas* L.) is a medicinal plant with hypoglycemic effect (Seymour *et al*., 2009; Mirbadal and Shirdel, 2010; Shamsi *et al*., 2010). It has extensive grown in some part of Europe and Asia includes Iran (Tetera, 2006). The analysis of biochemical characterizes Cornelian Cherry Fruit (CCF) obtained from Arasbaran region (northwest of Iran) had shown higher concentration of ascorbic acid content (183.25 to 299.5 mg 100 g^{-1}), phenolic compounds (2695.75 mg gallic acid 100 g^{-1} fresh fruit) and total antioxidant capacity equals to 82.37% (Hassanpour *et al*., 2011). The glucose and sucrose contents of fruit are in low concentration and Fe, Ca, vitamins (α-tocopherol, biotin, riboflavin and ascorbic acid) are in high concentration in fresh cornelian fruit (Zargari, 1997). The nutrients contents of CCF are presented as Table 1.

About medicinal aspects of fruit and its application in ethno-pharmacology or novel medicine, the literatures had listed various and multifunctional specifies for cornelian cherry. Results obtained from related studies shows anti-oxidative (Ersoy *et al*., 2011), antibacterial (Dulger and Gonuz, 2004; Krisch *et al*., 2008), hypolipidemic, hyperinsulinemic effect, weight losing (Jayaprakasam *et al*., 2006; Seymour *et al*., 2009; Shamsi *et al*., 2010; Mirbadal and Shirdel, 2010) effects of CCF. In traditional medicine, using CCF for treatment of

Table 1: Concentrations of some nutrients in fresh and dried cornelian cherry fruit (CCF), analysis

Compound	Dried fruit	Fresh fruit
Moisture (% DM)	9.12	327.53
Ascorbic acid (mg 100 g^{-1} DM)	228.82	419.08
Carotenes (mg 100 g^{-1} DM)	0.77	6.58
Total sugar (sucrose, glucose, maltose, etc.) (mg 100 g^{-1} DM)	63.22	48.41
Total protein (mg 100 g^{-1} DM)	0.27	0.5

DM: Based on dry matter, Rosu *et al*. (2011)

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fever, diarrhea and kidney and urinary bladder dysfunction was documented (Zargari, 1997; Dulger and Gonuz, 2004).

The experiments in relation to hypoglycemic effect of CCF were conducted in pathological or no-healthy conditions (diabetic or obese) (Seymour *et al*., 2009; Mirbadal and Shirdel, 2010; Shamsi *et al*., 2010), so, the aim of present experiment was to investigate the possible effects of dietary supplemented CCF for one, two or three meals on body weight, serum glucose and insulin levels of experimental rodent model in healthy condition.

MATERIALS AND METHODS

Present study was conducted during Dec. 2011 to Apr. 2012 at animal rooms and laboratories of Islamic Azad University. Thirty six one-month-old male hamsters (*Mesocricetus auratus*) were divided into four groups (9 animals in each group). All of experimental groups had one week pre-experiment adaptation period with same dietary and environmental conditions. Next, the dietary treatments were started by supplementation of dried CCF in one, two or three meals daily:

Group 1: Control fed basal diets without fruit supplementation
Group 2: Fed daily 5 g CCF only at first daily meal
Group 3: Fed daily 10 g CCF, at first and second daily meals
Group 4: Fed daily 15 g CCF, at first, second and third daily meals

The milled CCF was mixed into hamster diets. All of animals were weighted at onset and end of experiment and data were recorded to subsequent statistical analysis. At end of experiment (20 days), three animals from each group were selected randomly and blood sampling was done via injection into heart with regard to animal ethics recommendation of Islamic Azad University, veterinary department. For measurement of serum insulin and glucose concentrations, the blood samples were centrifuged and separated serum was analyzed by Auto-analyzer (Alyson 300, USA) and its commercial kits at Dr. Rastgoo bio-pathology laboratory (Tehran).

Statistical analysis: Experimental arrangement of present study was according to Completely Randomized Design (CRD) method. Obtained data were analyzed by SAS software (Ver. 9.1) and Duncan multiple ranges test was applied for detection of possible significant difference between means. Results were considered as significant when the p-value was less than 0.05.

RESULTS AND DISCUSSION

Body weight: The final body weight had decreased via CCF supplementation, linearly with time of meal and decreases in weight gain was more pronounced in group 4 (4.7 g) ($p<0.05$) in compared with control (18.5 g) (Table 2).

In a study on rabbit model (Rafieian-Kopaei *et al*., 2011), supplementation of CCF (1 g kg^{-1} b.wt., daily) for 60 days caused minor decrease in final weight when it compared with control group. Other studies with supplementation of sour cherry juice in diabetic women (Ataie-Jafari *et al*., 2008) and with supplementation of tart cherry in rat model (Seymour *et al*., 2009) had shown significant reductions in body weight were occurred.

In present study, dietary CCF caused significant reductions in final body weight. Also body weight reductions had negative correlation with supplementation amount (Table 2). Difference of present findings with Rafieian-Kopaei *et al*. (2011) may be explained by long duration of their experiment (60 days) that was more than present study. As the long duration of study can cause adaptation to CCF effect and avoid body weight losing that can be occurred with supplementation of cherry family (Ataie-Jafari *et al*., 2008; Seymour *et al*., 2009). Body weight declining may be occurred due to hypoglycemic effects of CCF that may be a clear reason for findings of present study and similar studies (Ataie-Jafari *et al*., 2008; Seymour *et al*., 2009).

Insulin level and glycemic status: Data shows significant glucose decreases in groups fed only one supplemented meal (group 1) ($p<0.05$) and it's correlated with elevation of insulin level. Supplementation of CCF for two or three times daily were not sufficient for more hypoglycemic effect and didn't have significant difference with glucose level of control group (Table 3). There was no any difference between insulin levels of group 2 and 3, but there was considerable elevation in insulin level for groups fed CCF in comparison with control rate (Table 3). Highest glucose rate was for control group (115 mg dL^{-1}),

Table 2: Body weight of hamsters fed cornelian cherry fruit (as daily meal supplementation)

Groups	No. of daily supplementation	Initial body weight (g)	Final body weight (g)	Weight gain (g)
1 (control)	0	94±1	112.5	18.5^{a}
2	1	94±1	105.6	11.6^{b}
3	2	94±1	100.1	6.1^{c}
4	3	94±1	98.7	4.7^{d}
p-value		-	-	<0.0001
SEM*		-	-	0.143

Different letters show significant differences between means of groups at $p<0.05$, *The standard error of difference between the mean

Table 3: Glycemic status of hamsters fed cornelian cherry fruit (as daily meal supplementation)

Groups	No. of daily supplementation	Glucose (mg dL^{-1})	Insulin (ng mL^{-1})
1 (control)	0	115.0000^{a}	0.860^{c}
2	1	90.7000^{b}	1.130^{a}
3	2	100.6000^{ab}	1.130^{a}
4	3	119.0000^{a}	1.030^{b}
p-value		0.0368	0.0001
SEM		6.0810	0.0210

Different letters show significant differences between means of groups at $p<0.05$

where insulin level was in low rate (0.56 ng dL^{-1}) ($p<0.01$). The lowest glucose concentration was for group 2 with 90.7 mg dL^{-1} ($p<0.01$).

Present results for glycemic status are in agreement with Shamsi *et al.* (2010) and Mirbadal and Shirdel (2010) in diabetic rats. The present results show insulin elevation in healthy animals as a completive finding. With attention to Table 3, insulin levels are increased for all of treatment groups fed CCF supplement. But hypoglycemic effect of CCF is limited to one meal supplementation of CCF or only group 2. Hypoglycemic effect of CCF for two time daily supplementation in not significant (115 mg in comparison with 100.6 mg, respectively for control and group 3), whereas CCF supplementation for 3 time (3 meals) daily didn't has any hypoglycemic effect. It seem that hypoglycemic effect of CCF is efficient when supplemented only for one time or one daily meal and more may be cause metabolic feedback effect for glucose obtaining to optimum glycemic regulations (ADA, 2010) may via breakdown of liver glycogen with subsequent elevation of the blood glucose level (Benjamin and Sandler, 1985).

The hypoglycemic effect of CCF is insulin-dependent, because groups with higher glucose level (control and group 4) had lower insulin level, when compared with group 2 and 3 (Table 3). In this regards, a current review (Patel *et al*., 2012) had stated that proliferation of pancreatic islets by post prandial secretion of insulin and stimulation of glucose transport. Also, Nair and Olson, (2005) in the published specific project report on CCF component, had concluded that improved insulin secretion by pancreatic beta cells is other potential benefits of CCF to diabetic patients. In present study, there was insulin-dependent hypoglycemic effect in healthy animal.

CONCLUSION

It was concluded that supplemented cornelian cherry fruit for one, two or three daily meal can decreases weight gain and for only one daily meal can caused considerable hypoglycemic effect, whereas supplemented for two or three times daily was not more efficient may due to glycemic regulation of healthy animals.

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