EFFECT OF SUMAC ON CHOLESTEROL AND TRIGLYCERIDES CONTENT OF RABBITS

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ABSTRACT
The aim of the present work was to investigate the effect of sumac (*Rhus coriaria L.*) addition to the diet on serum cholesterol and triglycerides content of male rabbits. Adult rabbits were divided into 5 groups: one control (C) and four experimental groups. Experimental animals (5 in each group) received sumac *per os* in feed in various doses (E1 – 0.50 %, E2 – 0.75 %, E3 – 1.0 % and E4 – 1.50 %) for 90 days. Blood samples were obtained once/twice per month (5 times – I., II., III., IV. and V. blood takings). After consumption of the sumac the content of cholesterol decreased significantly ($P<0.05$) in E4 group versus control group in blood takings I. and IV. Generally, it can be concluded that results of the present experiment for the first time suggest the effect of sumac on decrease of blood cholesterol level in rabbits.
Key words: *Rhus coriaria*, cholesterol, triglycerides, rabbit

INTRODUCTION
Sumac (*Rhus coriaria L.*, family *Anacardiaceae*) is the common name for a genus (*Rhus*) that contains over 250 individual species of flowering. These plants are found in temperate and tropical regions worldwide, often grow in areas of marginal agricultural capacity, and have a long history of use by indigenous people for medicinal and other uses (**Rayne and Mazza, 2007)**. Sumac is used as a herbal remedy in traditional medicine due to its antifibrogenic, antifungal, antiinflammatory, antimalarial, antimicrobial, antimutagenic, antioxidant, antithrombin, antitumorigenic, antiviral, cytotoxic, hypoglycaemic, leukopenic **(Rayne and Mazza, 2007, Gulmez et al., 2006)** and atheroprotective effects **(Zargham and Zargham, 2008).** Bacteriostatic/bactericidal effects of sumac were studied by **Nasar-Abbas and Halkman (2004).** This plant is known to be a rich source of tannin **(Zargham and Zargham, 2008)**. *In vitro* and *in vivo* studies shown that tannins have anticarcinogenic effect, such as the induction of cell cycle arrest and apoptosis as well as the inhibition of tumour formation and growth in animals **(Perchellet et al., 1992)**. It was published that sumac extract is promising as a source of natural antioxidants **(Ozcan, 2003)**. The methanolic extracts of *Rhus retinorrhaea* showed a remarkable radical scavenging effect even at low concentrations **(Mothana et al., 2009)**.
Based on this knowledge the aim of the present work was to determine the effect of sumac in various doses on serum cholesterol and triglycerides of male rabbit's blood.

MATERIAL AND METHODS
Experimental Design and Animal Management
Adult mail rabbits (n=25) of meat line M91, maternal albinotic line, crossbreed (New Zealand white, Buskat rabbit, French silver) and paternal acromalictic line, crossbreed (Nitra rabbit, Californian rabbit, Big light silver) were used in experiment. Rabbits were healthy and their condition was judged as good at the commencement of the experiment.
Water was available at any time from automatic drinking troughs. Groups of adult animals were balanced for age (150 days) and body weight (4.0±0.5 kg) at the beginning of the experiment. Adult rabbits were fed on a 12.35 MJ/kg of metabolizable diet composed of a pelletized concentrate (Table 1).

Animals were divided to 5 groups (n=5), control group (C) and four experimental groups (E1, E2, E3 and E4). Experimental groups received sumac (*Rhus coriaria L.*) integrated into the pelletized diet in amount of 0.50 % in E1 group, 0.75 % in E2 group, 1.0 % in E3 group and 1.50 % in E4 group for 90 days. Control group received feed without sumac addition.

Table 1 Diet composition of feed mixture for adult rabbits

Ingredients	
Dry matter	926.26 g/kg
Cruide protein	192.06 g/kg
Fat	36.08 g/kg
Fiber	135.79 g/kg
Non nitrogen compounds	483.56 g/kg
Ash matter	78.78 g/kg
Organic matter	847.49 g/kg
Calcium	9.73 g/kg
Phosphorus	6.84 g/kg
Magnesium	2.77 g/kg
Sodium	1.81 g/kg
Potassium	10.94 g/kg
Metabolizable energy	12.35 MJ/kg

Blood Sampling and Analyses

Blood samples (2 ml) from *vena auricularis* were taken from all animals by macromethods in morning once/twice per month during whole experiment.

For biochemical analyses blood samples were centrifuged for 30 min at 3000*x*g and blood serum was obtained. Serum cholesterol and triglycerides were determined using Ecoline kits on automatic analyzer Microlab 300 (Merck®, Germany) according to manufacturer conditions.

Statistical Analyses

The data presented concerning the effects of sumac are means of values obtained in five blood collections performed on separate days. To compare the results the analysis of variance, t-test and Duncan's test were realized to calculate basic statistic characteristics and to determine significant differences between experimental and control groups the SAS statistical software and statistical software Sigma Plot 9.0 (Jandel, Corte Madera, USA) were used. Data presented are mean±SD (standard deviation). Differences were compared for statistical significance at the level $P<0.05$.

RESULTS

Results of serum cholesterol values are summarized in Table 2. After consumption of the sumac (experimental groups) the content of cholesterol decreased in comparison with control group. Statistical evaluation showed significant decrease ($P<0.05$) between control group and E4 group (1.50 % of sumac) in I. and IV. blood taking.

Table 2 Effect of sumac on cholesterol content in rabbit blood

Group	Blood taking				
	I.	II.	III.	IV.	V.
C	1.23±0.59	1.06±0.27	1.31±0.46	1.08±0.30	1.08±0.27
E1	0.97±0.23	0.80±0.2	0.85±0.19	0.96±0.16	1.03±0.23
E2	1.13±0.34	0.86±0.12	1.04±0.22	0.87±0.19	0.91±0.12
E3	0.84±0.14	1.05±0.39	0.92±0.31	0.81±0.11	1.01±0.21
E4	0.75±0.12*****	0.77±0.16	0.71±0.18	0.61±0.20*****	0.58±0.15

C – control group, E1 (0.50 %), E2 (0.75 %), E3 (1.00 %), E4 (1.50 %) - experimental groups (sumac addition in %), the values shown are the mean±SD, significant at *p<0.05 level when comparing control group with the sumac groups (experimental)

As it is shown in Table 3, addition of sumac to the diet of rabbits had no effect on triglycerides level in blood as differences among the groups remained insignificant (P>0.05).

Table 3 Effect of sumac on triglycerides content in rabbit blood

Group	Blood taking				
	I.	II.	III.	IV.	V.
C	1.2±0.45	1.39±0.45	1.54±0.47	0.68±0.21	0.77±0.11
E1	0.92±0.45	1.26±0.66	0.96±0.34	0.51±0.17	0.68±0.23
E2	1.06±0.51	0.93±0.13	1.24±0.55	0.73±0.16	0.96±0.28
E3	0.76±0.12	1.06±0.14	0.87±0.11	0.74±0.18	0.92±0.18
E4	1.22±0.18	0.94±0.13	1.22±0.36	0.82±0.17	0.93±0.16

C – control group, E1 (0.50 %), E2 (0.75 %), E3 (1.00 %), E4 (1.50 %) - experimental groups (sumac addition in %), the values shown are the mean±SD, differences are not significant (P>0.05)

DISCUSSION

The place of herbs and spices in the diet needs to be considered in reviewing health benefits. The beneficial properties of spices are of particular interest in view of the impact of low-density lipoprotein cholesterol **(Tapsell et al., 2006).** Reduction of blood cholesterol in various animals was achieved by addition of various additives to the diet such as probiotic strains **(Salma et al., 2007; Hosono, 2001)**, herbal extracts (*Melissa officinalis* L., *Morus alba* L., *Artemisia capillaris Thunb*) **(Lee et al., 2008)**, green tea **(Lee et al., 2009; Wolfram et al., 2006)**, garlic **(Tapsell et al., 2006)** and others. Reduction of plasma cholesterol in rats was result of oral administration of *Boerhavia diffusa* leaf extract (**Pari and Satheesh, 2004)**, or *Cuminum cyminum* **(Dhandapani et al., 2002)**. A combination dietary supplement containing vitamins, minerals, herbs, fibers and amino acids in human trials was associated with a corresponding statistically significant decrease in total cholesterol in adult (**Gonzales et al., 2004)** and also in children **(Gonzales et al., 2005).** Evidence from various studies indicates that many herbal medicinal products have potential hypocholesterolemic activity and encouraging safety profiles. However, only a limited amount of clinical research exists to support their efficacy **(Thompson Coon and Ernst, 2003)**. In the present study consumption of sumac during 90 days caused decrease of cholesterol in blood of rabbits, in case of group with highest level of sumac (1.5 %) significantly (P<0.05) on the beginning of the experiment (I. blood taking) and at the end of experiment (IV. blood taking). Similar results were obtained in case of mice but with other kind of *Rhus* where glycoprotein isolated from *Rhus verniciflua* fruit for two weeks resulted in a significant decrease in plasma total cholesterol **(Oh et al., 2006)**.

CONCLUSION

In conclusion, oral administration of sumac in amount of 1.5 % to the diet of rabbits significantly resulted in reduced level of blood cholesterol. To our knowledge, there are rare similar studies on the effect of sumac in rabbit's nutrition and its effect on biochemical parameters. Therefore the results of the present study require further experiments to complete the whole task. The research on the field of various natural additives to the food will be worthy of further investigation.

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