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Phytochemical analysis of *Cynara scolymus* L. cultivated in Mongolia

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Abstract: *Cynara scolymus* L. (Artichoke) is a traditionally consumed vegetable in many countries. In Mongolia, this plant has been successfully cultivated during the last years. The present study is an attempt to investigate the phytochemical composition of *C.scolymus* L. The result reveals the presence of bioactive constituents comprising flavonoids, total phenolic compounds, saponins and total proteins, carbohydrates, lipids and vitamin C in plant parts. The presence of these phytochemicals can be correlated with the medicinal potential of this plant.

Keywords: Cynara scolymus, Compositae, phenolic compounds, flavonoids

INTRODUCTION

Cynara scolymus L. is a perennial plant of Compositae are growing up to 1.5-2 m high. The flowers develop in a large head from an edible bud about 8–15 cm diameter with numerous triangular scales. *C.scolymus* head and leaves extracts have long been used in folk medicine for their choleretic and hepatoprotective activities, primarily for enhancing liver function and to treat chronic liver and gall bladder diseases, jaundice, hepatitis, arteriosclerosis and symptoms of diabetes, that are often related to the cynarin content [1-3], also used as functional food preparations. These therapeutic properties are also attributed to mono- and dicaffeoylquinic acids [1-4]. *C.scolymus* leaves contain up to 2% of phenolic acids, mainly chlorogenic acid, cynarin, and caffeic acid; 0.4 % of bitter sesquiterpene lactones of which 47-83% is cynaropicrin, grosheimin; 0.1-1% of flavonoids like luteolin including the glycosides as luteolin-7-O-rutinoside (scolymoside), luteolin-7-O-$^{\beta}$-gluco-pyranoside (cynaroside), apigenin-7-O-rutinoside, cynarasaponins and inulin [5-7].

Research studies of *C. scolymus* leaf extract has shown antioxidative, antibacterial, anti-HIV, bile-expelling, hepatoprotective, urinative and choleretic activity, as well as the ability to inhibit cholesterol biosynthesis and LDL oxidation [3, 8]. Although the extract has been used as medicine for many years, it has not been extensively examined as an antimicrobial agent.

C. scolymus can be eaten as a fresh, canned or frozen vegetable [9]. Historically, this plant has been used in folk medicine since Roman times, for its health benefits which are mainly due to high content of polyphenols and inulin [9, 10]. These substances are very important for the human nutrition since they are involved in the prevention of cancer [11]. Among the common edible plants, it is the richest source of dietary antioxidants [12] therefore it could be used in phytopharmaceutical applications [9, 13].

EXPERIMENTAL

Materials and Methods: Leaves, flower (bulb), and root of *C.scolymus* were obtained from experimental plot of the Research & Training Center "Nart" of Mongolian State University of Agriculture, in September 2011 during flowering stage. The collected plant material was air-dried in darkness at room temperature (20^{0}C). Dried plant materials were cup up and stored in dark conditions until for further use.

The moisture content was determined by drying at 105^{0}C to constant weight, ash content by high temperature incineration in a muffle furnace [14], total lipids by Soxhlet, and carbohydrates by the Bertrand's method, ascorbic acid by titrimetric method. The crude protein content was determined by Kjeldahl method, and protein content was estimated using a nitrogen factor of 6.25 [15, 16].

The total phenolic contents in plant parts were determined by spectrophotometrically according to Folin-Ciocalteu method. Gallic acid was used to set up the standard curve. The content of phenolic compounds of the samples was expressed as gallic acid equivalents (GAE) in mg/gram dry weight. The

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$AlCl_3$ method [17, 18] was used for quantification of the total flavonoid content of the plant parts. The absorbance was determined using spectrophotometer at λmax=415 nm. Flavonoid contents were expressed as quercetin equivalents in mg/g dry material [17]. All the samples were analyzed in triplicates. Data are presented as means and standard errors of the mean.

The parts of *C.scolymus* showed either presence or absence of different phytochemicals. The preliminary phytochemical analysis showed that phenolic compounds, flavonoids and saponins were present in all parts of the plant, but absent coumarins, alkaloids and tannins.

The leaves of *C. scolymus* L. have high quantity of total phenolic compound (50 GAE, mg/g).

Table 1. Chemical composition of *C. scolymus*

Parts of plants	**Mois-ture,%**	**Ash, %**	**Aqueous ex-tractable com-pounds, %**	**Total protein,%**	**Total carbo-hydrate, %**	**Lpids, %**	**Vitamin C, mg%**
Flower,	6.3+0.1	5.8+0.2	20.8+0.2	13.5	56.5	0.1	12.2
Leaves	5.5+0.05	7.9+0.7	21.0+0.2	12.6	56.9	0.1	16.0
Root	5.4+0.05	7.8+0.9	16.4+0.2	12.9	58.3	0.1	12.8

Table 2. Phytochemical screening of *C.scolymus*

Parts of plant	**Phenolic compounds**	**Flavonoids**	**Alkaloids**	**Saponins**	**Tannins**	**Coumarins**
Flower, head	+	+	–	+	–	–
Leaves	+	+	–	+	–	–
Root	+	+	–	+	–	–

RESULTS AND DISCUSSION

The results of chemical analysis of *C. scolymus* were reported in Table 1, phytochemical screening of the plant parts are summarized in Table 2 and phytochemical constitiuents in the plant were summarized in Table 3.

Table 3. Phytochemical analysis of *C.scolymus*

Parts of plant	**Total phenolic compounds, GAE, mg/gram**	**Flavonoids, %**	**Saponins, %**
Flower, head	45	0.07+0.01	2.1+0.01
Leaves	50	0.15+0.02	2.9+0.05
Root	-	0.05+0.01	1.5+0.04

The results of moisture analysis showed that, moisture content of *C.scolymus* cultivated in Mongolia was (5.4-6.3±0.2). The same trend were recorded with protein (12.6–13.5; 12.39) and carbohydrate (56.5–58.3; 56.72) contents for *C.scolymus* cultivated in Mongolia and Egipt respectively. The total lipid of *C.scolymus* was 0.1 % and for baby anzio was 3.78 %. From the obtained results we noted that the protein and carbohydrate content in *C.scolymus* cultivated in Mongolia significantly higher than baby anzio (Egipt) [19] species but less in lipid content.

The host of natural antioxidant essentially represented by the phenolic compounds used as nutraceuticals, and found in apples, green-tea, and red wine and in many medicinal plants as phytochemical or secondary metabolites.

The percentage of total flavonoids in leaves was (0.15 ± 0.02%). This moderately high level of flavonoid present in the leaves could be attributed to its antioxidant capacity. High levels of saponins (2.9 ± 0.05%) are found in the leaves of *C.scolymus*. This high level of saponins present in the leaves directly correlates with the fact that the leaf of *C.scolymus* has been used traditionally as medicine for cancers [6]. Leaves were found to contain total phenolic compounds, and vitamin C which were similar with data resulted from *C.scolymus* cultivated in the other countries [19].

CONCLUSIONS

It can be concluded from the present study that the plant parts of *C.scolymus* possesses various phytochemicals like total phenols, saponins, flavonoids, proteins and vitamin C in high quantity. These phytochemicals possess various bioactive properties and may be used as external therapeutic supplement. We are now trying to identify and isolate the different phytochemicals from the leaf of *C. scolymus* and to test these bioactive compounds for their antioxidant and anti-cancer activity. The characterization of *C.scolymus* is very important to improve its cultivation and future marketing in Mongolia.

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