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Health attributes of ethnic vegetables consumed in the Eastern Anatolia region of Turkey: Antioxidant and enzyme-inhibitory properties



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ABSTRACT

Background: Four ethnic vegetables from the Eastern Anatolia region of Turkey, *Malva neglecta* Wallr., *Plantago lanceolata* L., *Cichorium intybus* L. and *Eryngium bornmuelleri* Nab. are commonly used by the local population for food preparation. This study aimed at understanding their potential health attributes.

Methods: Hydrophilic extracts obtained from roots, stems, leaves and flowers were evaluated for their antioxidant capacities [total phenolics (TP), ferric reducing antioxidant power (FRAP), and oxygen radical absorbance capacity (ORAC) assays] and suppression of two isolated key enzymes relevant to metabolic syndrome: α -glucosidase and pancreatic lipase. Phytochemical composition of extracts was investigated by high performance liquid chromatography (HPLC) and liquid chromatography mass spectrometry (LC-MS). **Results:** The evaluated extracts exhibited pronounced antioxidant capacities, comparable to those of common spices and herbs, and effectively suppressed the activities of isolated α -glucosidase and pancreatic lipase enzymes. These activities correlated well with total phenolics contents. *Plantago lanceolata* was an effective inhibitor of α -glucosidase and *C. intybus* of pancreatic lipase enzyme. High performance liquid chromatography mass spectrometry analyses revealed the dominance of luteolin glycosides in *P. lanceolata*. The same compound was present in *C. intybus*, where it was accompanied by significant amounts of cichoric, chlorogenic and caftaric acid. *Malva neglecta* and *E. bornmuelleri* contained the lowest levels of phenolic compounds and exhibited the lowest antioxidant and enzyme inhibitory activities.

Conclusions: Among the investigated ethnic vegetables, *P. lanceolata* and *C. intybus* represent a valuable source of antioxidant phytochemicals of phenolic nature that modulated *in vitro* the activities of digestive enzymes. These ethnic food sources diversify diet and enhance health attributes of foods.

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1. Introduction

Ethnic foods comprise all of the edible species that are available from local natural resources and prepared in accordance with the

accepted patterns for their use within a particular culture [1]. Ethnic cuisine develops as the result of a fine interplay between two factors: (1) biodiversity of available food resources and (2) cultural inheritance and social changes. Ethnic foods accumulate the local knowledge and understanding of foods generated over centuries and are an essential part of cultural inheritance. Locally grown plants, including fruits, vegetables, herbs, and spices, are the basic ingredients of ethnic foods. Therefore, the local biodiversity directly affects the diversity of ethnic foods created in particular regions. Beside the available food sources, the local culture, history, and social changes equally importantly influence the development of ethnic foods.

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The ethnic Turkish cuisine is rich, based on numerous stews of vegetables and meat (predominantly lamb and beef) frequently accompanied by sourdough bread. A few ethnic foods from Turkey have become renowned across the world, with the Turkish kebab, dolma dishes, and borek being the most popular. Turkish kebab is made from meat roasted in pieces or slices on a skewer or as meatballs on a grill. Afyon kebab from Central Anatolia is prepared from boiled meat cubes, placed over bread and topped with vegetables and sauce (Figure 1). Dolma are vegetable dishes based on tomatoes, peppers, eggplants, and/or edible leaves (grape, cabbage, locally growing unconventional vegetables—*Malva* sp. and others) that are stuffed with or wrapped around rice or bulgar pilaf, ground meat, or spices (Figure 2). Borek is a pastry made of many thin layers of dough interspersed with cheese, spinach, and/or ground meat. It includes a sweet desert served on special occasions called baklava (Figure 3), which is made of pastry interspersed with nuts and immersed in honey-based syrup.

Savage plants and common vegetables, including olive oil-based dishes, represent the vast variety of ethnic foods in Turkey. These foods are frequently based on fried vegetables, fruit molasses, marmalades, sundried tomatoes, and pimento (allspice). Legumes and assorted vegetables are among the common local foods, with eggplants being the most commonly used and utilized in fried dishes, salads, and desserts. Food preparations and composition of the ingredients vary greatly by region and ethnicity. For example, the Black Sea region is noted for fish dishes, the eastern region for lamb and spicy vegetables dishes, while the southeastern region is known for Armenian pizza, thick corn Georgian bread, and corn soup.

Two important factors that have influenced the development of ethnic foods in Turkey are the exceptional biodiversity of the region and social changes. Over centuries, the country has served as a passageway between Europe, Asia, and Africa, where different cultures, traditions and experiences generated in distant lands have collided. A variety of flora, fauna, and cultures owe their geographical spread to this passageway. Their fusion played a decisive role in the development of the exceptionally rich Anatolian ethnic foods. Ethnic foods of Eastern Anatolia are predominantly based on spicy lamb dishes accompanied by a large variety of vegetable meals created from locally grown ethnic vegetables. This region, located in the Asian part of the country, represents the largest of geographical divisions with 14 provinces, bordering Iraq, Iran, Nakhichevan, Armenia, and Georgia and is covered with deciduous-mixed forests and deciduous tree steppes [2]. The area is



Fig. 1. Afyon kebab from Central Anatolia.



Fig. 2. Ethnic dish called “yaprac sarma” (a type of dolma) made of leaves (grape, *Malva neglecta* or other) stuffed with minced meat and rice prepared by the locals of Eastern Anatolia.



Fig. 3. Baklava – a sweet desert made of pastry, nuts and honey-based syrup.

surrounded by coastal mountain ranges, which protects it from the moderating effect of sea breezes. Subsequently, the winters are cold and long, with snow lasting for several months. They are followed by short and rainy springs, and hot and dry summers. The mountainous and strongly fragmented area offers numerous microclimatic and ecological zones, which provided suitable conditions for the development of diverse flora [3,4]. The Eastern Anatolia region is regarded as one of the richest areas of plant biodiversity with > 3,000 vascular plant taxa, of which, nearly 800 are endemic. The most important floral biodiversity centers in Eastern Anatolia are Munzur and Anti Taurus Mountains, Elbistan–Darende, Kemaliye, Kesis Mountain, and Harput and Hazar Lake [2]. Traditionally, the local people of the mountainous Eastern Anatolia were isolated from large cities and forced to rely exclusively on local food production, utilizing the locally grown ethnic vegetables (Figure 4). To date, these vegetables are especially important in rural areas, where opportunities to purchase commercially grown conventional vegetables are still limited. Locally grown *Plantago lanceolata* (giyamambel), *Malva neglecta* (tolk), *Eryngium bornmuelleri* (tûsi), and *Cichorium intybus* (kanej or tahlışk) (Figure 5) are the most common ethnic vegetables used in preparation of main meals in

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