



Review

Rose hip as an underutilized functional food: Evidence-based review



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ABSTRACT

The search for nutrient-dense food source is a top-priority in today's food-challenged world of multi-billion population. Food insecurity has become especially critical in developing countries, though potential sources of functional foods are being wasted right before our eyes. Rose hips, the fruits of rose plants (*Rosa* sp.) have been discovered to be rich in polyphenols (triterpene acids, flavonoids, proanthocyanidins, catechin), essential fatty acids, galactolipid, folate, vitamin A, C and E, minerals (Ca, Mg, K, S, Si, Se, Mn and Fe), among other bioactive components. The extracts have been proven to possess antioxidant, anti-inflammatory, immunomodulation, anticancer, cardioprotective, antidiabetic, neuroprotective, and antimicrobial properties. The extracts have been validated beneficial against non-alcoholic fatty liver disease, osteoarthritis, rheumatoid arthritis, obesity, cancer, kidney stone, depression, dermal issues, among other pathologies. The mechanisms of therapeutic actions involve intervention in COX-2, iNOS, NF-kappaB, PPAR- γ , p38 MAPK, Bak, Caspase-3, Ca⁺⁺ channel blockade pathways. Barring the Rosaceae family-characteristic allergenicity due to LTPs, the rose hips are free of other side effects. This holistic review, based on recent findings is excited to report rose hips as an emerging 'functional food' that deserves to be integrated to food platter without delay.

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1. Introduction

As world population rises and natural resources dwindle, availing sufficient nutritious food for all has become a serious issue (Karhagomba et al., 2013). Chronic micronutrient deficiencies affect over two billion people worldwide (Burchi, Fanzo, & Frison, 2011). Scale-up of food production in sustainable manner is a major challenge. In this regard, prospecting of natural food sources from biodiversity is a solution (Patel, 2015a). It turns out that several candidates with nutritive relevance have been left out back then when food was abundant. Over the years, many underutilized food sources have been recognized and their nutritional and safety assessment is being conducted. Functional food potentials of these emergent foods are being profiled. The term 'functional food' embraces the edible components with potential to nourish as well as to improve antioxidant, mutagen-combating, and immune status of body. These are foods that furnish health benefits when fortified to regular diet on a regular basis at sufficient levels (Hasler, 2000).

One such unexploited nutrition source is rose hip, the fleshy fruit of roses. Family Rosaceae comprising of about 100 genera and 3000 species is well-known to encompass a huge number of nutritious, palatable fruits like apple, pear, plum, cherry, peach, apricot, nectarine, almond, strawberry, raspberry, and blackberry (Jung & Main, 2014). This family also contains a wide variety of

ornamental plants including rose, flowering cherry, crabapple, quince and flowering pear. The genus *Rosa* encompasses about 100 species, with geographical distribution predominantly spanning Europe, Asia, and North America (Czyzowska, Klewicka, Pogorzelski, & Nowak, 2014). This genus is cultivated for the ornate flowers, where the bulbous fruits (hypanthium/haw) located below the petal corolla, known as rose hips are discarded (Fig. 1). The fruits contain numerous hairy achene-like seeds, which contain oil of emollient value. Fig. 1 shows the rose hips and the seeds, which contain the oils.

In certain cultures, rose hips are relished as food and in some other they are used as medicines. Consumption of rose hips is popular in European countries such as Poland, Portugal, Germany, Finland, Romania and Sweden, though they are especially popular in Scandinavian countries. The hips are processed into dessert, cookies, cakes, bread, jelly, marmalade, ice cream, pudding, custard soup, pie, syrup, herbal tea, beverages etc. (Dobosch, Gomez Zavaglia, & Kuljich, 1995). *R. canina* hips are widely consumed in countryside Portugal (Barros, Carvalho, & Ferreira, 2011). Nypon-soppa is a rose hip soup popular in Swedish cuisine. Hagebuttem is a traditional German rose hip soup. Dzika Róza Zachowaniais is a Polish rose hip preserve. Many berries, including rose hip in Finnish diet has been analyzed to be rich in the hydrolyzable tannins ellagitannins (Koponen, Happonen, Mattila, & Törrönen, 2007). In

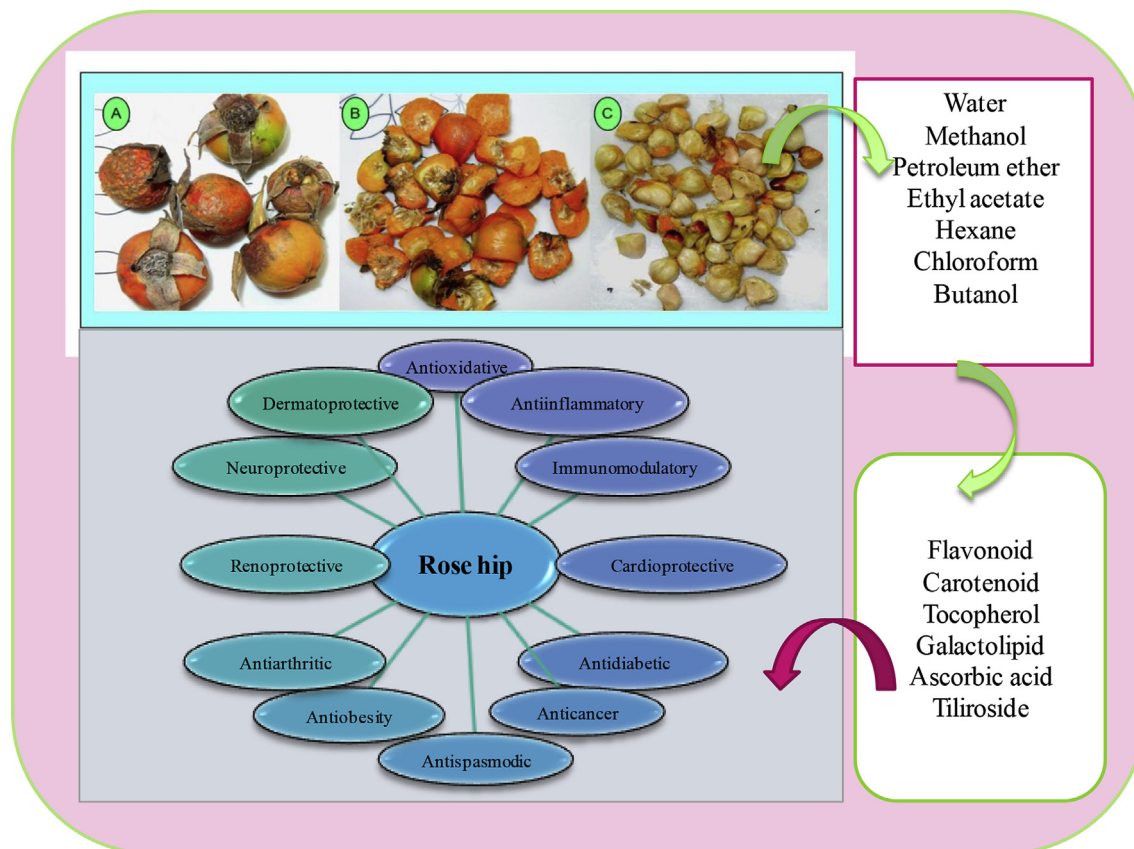


Fig. 1. (A) Ripe rose hips (B) Fragmented rose hips (C) The seeds. The solvents used for extraction of bioactive fractions, the phytochemicals and the biological benefits.

Romania, *Rosa* varieties and rose hips are abundant. They use the fruits in myriad forms as support therapies to supplement their vitamin A and C intake (Oprica, Bucsa, & Zamfirache, 2015). Palinka is a traditional Hungarian brandy made of fruits, which includes rose hips too (Small, 2014). British people relish their rose hip tea. Rose hip is a major herbal remedy in Turkey (Nur, 2010). *R. canina* fruits are also used as snacks in Turkey (Gürbüz, Ustün, Yesilada, Sezik, & Kutsal, 2003). In the Tokat region of Anatolia, Turkey, rose hips are processed into marmalade, and juice (Günes, 2013). In this country, rose hips are well-appreciated for their aromatic and medicinal properties (Patel, 2012). Rose hip is consumed as herbal tea and used as folk medicine in Iran for common cold, gastric disorder, gallstones, constipation and dropsy (Montazeri, Baher, Mirzajani, Barami, & Yousefian, 2011). Even in the USA, foragers relish it as snacks, syrup and sauce (Small, 2014). The Chumash Native Indians consumed the hips of *R. californica* (California wild rose) raw, cooked or brewed. Samish Indians in Washington State consumed the hips as jelly and wine. *R. canina* L. and *R. corymbifera* Borkh fruits are consumed or topically applied for relief from cold, influenza, infections, diarrhea, inflammations, and pain (Barros, Carvalho, Morais, & Ferreira, 2010). Hips from *R. roxburghii* Tratt., native to China is used for nutritional and medicinal purposes (Yan, Zhang, Lu, He, & An, 2015). *R. multiflora* hips have been used as dietary supplements and remedies for illnesses like cold, flu, inflammation, osteoarthritis, rheumatoid arthritis and chronic pain in China. Rose hip seed-derived oil has immense popularity as skin emollient in Chile. However, global consumption of rose hip is sparse. Only recently, as the craze for health foods escalated, they have garnered attention. Ever since the high-end analytical and phytochemical analysis techniques were adopted, the hips have been validated to have edible ingredients like other Rosaceae fruits.

Facts are emerging that they are nutrient-dense and ideal candidate for dietary incorporation, for direct consumption or as food additives. Nutritional analyses have suggested the usage of rose hips as functional food and natural colorants in food technology (Rosus et al., 2011). With interesting findings on their functional food relevance, several patents on rose hip processing have been filed, and they are either being evaluated for nutritional uses or have entered to mainstream food processing. *R. rugosa* and *R. canina* wines revealed high antioxidant activity as measured by ABTS, and DPPH assays. Wine from *R. canina* showed appreciable anti-mutagenic effect *in vitro*, as it lowered the level of the mutagen *N*-methyl-*N'*-nitro-nitrosoguanidine in a dose-dependent manner (Czyzowska et al., 2014). *R. laevigata* Michx hip-derived wine was evaluated for its phenolic composition and antioxidant activities by standard assays. The beverage had higher contents of total phenolics, total flavonoids, and oligomeric proanthocyanidins than Cabernet Sauvignon wine, suggesting usage of the rose hip juice to wine (Meng et al., 2012). *R. canina* hip addition to frankfurters acted as a partial substitute of the antioxidant sodium nitrite (Vossen, Utrera, De Smet, Morcuende, & Estévez, 2012). Rose hip addition to broiler meat numerically decreased 2-Thiobarbituric Acid Reactive Substances (TBARS) (indicator of lipid oxidation prevention) and enhanced carcass weight (Loetscher, Kreuzer, & Messikommer, 2013). In the coming times, more rose hip-valORIZED food products are expected. However, what makes these hitherto obscure Rosaceae fruits worthy of functional food has been discussed in the following sections.

2. Phytonutrients

Analytical studies have unveiled the presence of several

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