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Editorial

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# Plums as Potential Dietary Agents to Prevent Obesity and Obesity-Related Disorders

**Rafat A Siddiqui***

## Abstract

Obesity is a serious issue in both developed and developing world. The obese people are often hyperglycemia, dyslipidemia, and hypertensive and therefore, are pre-disposed to type 2 diabetes and cardiovascular diseases. It is generally known that eating fruits and vegetables can prevent body weight gain and can reduce the risk of chronic diseases. Recent research has identified several kinds of fruits and vegetables that are important in reducing inflammation and preventing metabolic syndrome. However, the sugar content of fruits can be problematic for obese patients with diabetes. Plums and prunes (dried plums) are rich is fiber and have low glycemic index. Consumption of plums (prunes) helps growth of beneficial gut bacteria, reduces fats deposit in tissues, improves lipid and glucose metabolism, and reduces inflammation. The consumption of plum or prunes causes modulation of cellular pathways that are deregulated in obesity. In conclusion regular consumption of plums or prunes can potentially be very helpful in preventing and/or managing obesity and obesity-related disorders.

**Keywords**

Obesity; Plums; Prunes; Gut-bacteria; Lipid metabolism; Diabetes

Obesity results from accumulation of fats in the body to an extent that it creates a serious risk to overall health. Excessive accumulation of fat in adipose, liver, heart, pancreases and other tissues results in a combination of metabolic disorders known as "metabolic syndrome" and characterized by hyperglycemia, dyslipidemia, and hypertension that predisposes obese people to type 2 diabetes and cardiovascular diseases [1-4]. Furthermore, obesity is also linked to several types of cancers [5-7]. According to Center for Disease Control (CDC) more than one-third (36.5%) of U.S. adults have obesity [8]. In 2014 the global economic impact of obesity was estimated to be US $2.0 trillion or 2.8% of the global gross domestic product [9]. In developing countries, obesity is also becoming an emerging disease due to a shift toward a western life style for consuming processed food rich in fats and carbohydrates [3,4].

Nutrient and physical activity play an important role in the progression of obesity. The CDC reports that proper nutrition and exercise can prevent or reverse obesity [10]. It is generally known that eating fruits and vegetables can prevent body weight gain and can reduce the risk of chronic diseases [11]. Recent research has identified several kinds of fruits and vegetables that are important in reducing inflammation and preventing metabolic syndrome [12] and this list is growing as new biological activities are discovered for the bioactive compounds present in the natural products. One such fruit is a plum, because the recent experimental evidences indicate that plums may be very beneficial for preventing or treating obesity.

Plum has about 40 species; however, only two species, the European plum (*Prunus domestica*) and the Japanese plum (*Prunus salicina*), are commercially recognized worldwide [13]. The European plum originated near the Caspian Sea about 2000 years ago and was introduced into the USA in the 17th century. The Japanese plum was originated in China but was mostly cultivated and developed in Japan and was introduced into the USA in the late 19$^{th}$ century [14]. Plums are dried for longer storage and often referred as prunes. Dried plums (prunes) are extremely low in fat, rich in macronutrients including both soluble (pectin) and insoluble fibers, oligosaccharides, simple sugars and sugar alcohol (sorbitol), as well as micronutrients like vitamins and minerals [14-16]. Several studies demonstrated that prunes are also rich sources of polyphenolic derivatives including chlorogenic acid, neochlorogenic acid, cryptochlorogenic acid, and oligomeric proanthocyanidin [16,17].

A growing number of studies have documented effects of plums or prunes that directly and indirectly relate to promote healthy metabolism and can be beneficial in controlling obesity. For example, plums or prunes promoted satiety when consumed as snacks; therefore, can limit food intake [18]. Interestingly the satiating effect of dried plums occurred concurrent with suppressed plasma glucose and insulin responses [18]. Furthermore, fibers and oligosaccharides in prunes act as prebiotics (food for microorganisms) and promote the growth of the healthy microorganisms in gut which help in nutrient absorption, removing toxins, improving mucosal immunity, decreasing fat metabolism and reducing pathogen colonization [19]. Plums associated- changes in gut bacteria (Faecalibacterium, Lactobacillus, and Bacteroidetes species) prevented weight gain in obese rats [20]. In human subjects, consumption of prunes essence concentrate also improved the population of beneficial bacteria, especially Bifidobacterium, Lactobacillus species [21]. It is also suggested that in addition to fibers, chlorogenic acid present in prunes may be metabolized by the intestinal microbiota to produce caffeic acid, which favors the proliferation of Bifidobacterium and Lactobacillus [20,22]. These bacteria colonization suppressed the intestinal pH, elevated production of short chain fatty acids, and also decreased intestinal cholesterol absorption [19,23,24]. Plums have low glycemic index because colonic fermentation results in a slower appearance of glucose into the blood stream [25].

Stacewicz-Sapuntzakis et al. [15,24] suggested that prunes lower the cholesterol level through enhancing bile acid excretion, and diverts excess cholesterol to bile acid synthesis. Several pre-clinical and clinical studies suggested that consumption of prunes extracts or concentrate suppressed the cholesterol level as well as lowered the LDL-oxidation [15,24,26]. Plum juice consumption decreased total cholesterol and triglycerides in plasma and significantly increased the ratio HDL-cholesterol/T-cholesterol in obese Zuker rats [27]. These study suggest that consumption of plums (prunes) may decrease the risk of obesity-induced CVD, because of its antioxidant activity [15,24,26,28]. An earlier study showed that plum treatment

***Corresponding author:** Rafat A. Siddiqui, Nutrition Science and Food Chemistry Laboratory, Agriculture Research Station, Virginia State University, Petersburg, VA 23804, USA, Tel: (804) 524 5957; E-mail: rsiddiqui@vsu.edu

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for 2 weeks reduced areas under the curve (AUCs) for glucose and insulin during a glucose tolerance test in db/db mice [29]. Plum treatment significantly increased plasma adiponectin concentrations and PPARγ mRNA expression in adipose tissue from Wistar fatty rats [29]. Plum thus may increase insulin sensitivity in these rats via adiponectin-related mechanisms. Plums juice also decreased the leptin levels in plasma of rats [27]. Furthermore, plum juice consumption decreased fat deposits in liver and heart tissues, inhibited adhesion molecules (ICAM-1 and VCAM-1), prevented NF-κB activation, and decreased biomarkers of inflammation and hypertension [26]. These effects were suggested to be mediated through PPAR-γ-agonist activity. Activation of the PPAR-γ in adipose tissue is associated with regulation of adipose derived substances that are altered in obesity and insulin resistance [30]. Another study showed that Queen Garnet plum (GGP), a variety of the Japanese plum, improved cardiovascular and hepatic structure and function and reduced metabolic parameters such as bodyweight gain, visceral adiposity index and total body fat mass induced by the high fat diet [31]. The consumption of QCP also improved plasma lipid profiles by reducing plasma concentrations of triglycerides, total cholesterol and non-esterified fatty acids. Furthermore, the reduction in adipose tissue with QGP was correlated with decreased plasma leptin concentrations. Leptin is a hormone secreted from adipose tissue [32] and a leptin deficiency was found to promote weight regain by stimulating appetite and reducing energy output [33]. Population studies have also indicated that approximately 10% of obese individuals have low plasma leptin levels [34]. Leptin is a critical factor that link reduced energy stores to eating behavior. It is suggested that leptin therapy could sustain weight loss by overriding the tendency toward energy conservation [35].

The studies described above clearly show the beneficial effects of plums or prunes help to attenuate obesity and obesity-related disorders. It is evident that consumption of plums or prunes has resulted in modulation of cellular pathways that are deregulated in obesity. Consumption of prunes can also be very helpful for diabetic and CVD patients. Further studies are required in this area to understand the cellular and molecular mechanism for the beneficial effects of prunes on human health that are not yet commonly known. In conclusion regular consumption of plums or prunes, a low glycemic fruits, can potentially be very helpful in preventing and/or managing obesity and obesity-related disorders.

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## Author Affiliations

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*Nutrition Science and Food Chemistry Laboratory, Virginia State University, USA*