A COMPREHENSIVE REVIEW ON FUNCTIONAL BENEFITS AND THERAPEUTIC USES OF FRUIT PEELS

Abstract

Oxidative stress is the most common risk factor common for the various metabolic disorders like diabetes and degenerative diseases like cancer. Fruit peels are rich in polyphenols, minerals, and vitamins and have a low glycemic index. Fruit peels offer qualities that are anti-inflammatory, anti-cancer, anti-microbial, antioxidant, and anti-diabetic. Furthermore, despite being recognized to contain potentially useful substances including carotenoids, dietary fiber, enzymes, and polyphenols, peels, pods, pomace, seeds, and stems are frequently thrown. The generation of waste causes serious economic and environmental burden in addition to the micronutrient deficiencies in humans. So supplementing fruit peels for therapeutic benefits is currently required. However, this component of research is still little understood and may not be frequently reviewed, hence this review will concentrate on the different aspects of fruit peels which includes antioxidant, anti-inflammatory, anti-diabetic, anti-microbial properties.

Keywords: fruit peels, therapeutic uses, antioxidants

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I. INTRODUCTION

As the population of the country increases rapidly, it the right time to act on the maximum utilization of resources and minimize the wastage for the environment and to improve sustainability. India is the leading producers of fruits and vegetables and also the perishable food waste. It accounts for about 40% of the total production. This review emphasis on the utilization of fruit peels for the effective treatment and management of various infectious, inflammatory and metabolic diseases and disorders.

The major health problems prevalent among the world population includes diabetes mellitus, cardiovascular diseases and cancer. These are responsible for the higher increase in the mortality and morbidity patterns of human population.

Through the investigation of novel food preparation methods, improvements in current technology in food engineering, preservation, and storage facilities have increased the number of potential therapeutic targets.

Recent years have seen a dramatic increase in the amount of reports that are available on fruits and vegetable peels, with a focus on their biological activity, content of various bioactive compounds, chemical characterization, comprehension of relationships between structure and activity, isolation and purification of commercially significant chemicals, and incorporation into foods.

Peels from fruits and vegetables should offer a wealth of opportunities for drug discovery and the creation of affordable treatments with few to no adverse effects. The growing interest in fruit and vegetable peels as a source of nutrition and therapeutic benefits has a significant impact on illness prevention and management. (8)

II. ANTI-OBESITY AND ANTI – DIABETIC EFFECTS

A flavonol pigment called quercetin can be found in many fruits and vegetables. By inhibiting pertinent protein kinases in L6 myotubes, its mode of action in the context of diabetic skeletal muscle was investigated. It was discovered that quercetin stimulates glucose absorption primarily through the AMPK route and its downstream p38 MAPK pathway rather than the insulin signaling pathway. The increase in intracellular calcium following treatment with quercetin also suggested that calcium-calmodulin mediated protein kinase (CaMKK) may also be involved. (1)

Another study found that giving Japanese people who are predisposed to developing diabetes sudachi peel extract power, which contains 4.9 mg of sudachitin daily for 12 weeks, resulted in a 3.6% reduction in the ratio of visceral to subcutaneous fat compared to the placebo group. Additionally, a 4% reduction in waist circumference was seen. (2)

Citrus fruit peels' therapeutic potential for treating obesity or the related metabolic syndrome, as well as the underlying physiological and molecular mechanisms, have been demonstrated by research studies. Numerous bioactive citrus flavonoids worked through a variety of intracellular pathways and different targets to combat obesity, diabetes, and other

related diseases. This multi-layer regulation appears to be a benefit for the creation of drugs to treat obesity and other metabolic illnesses. (3)

Additionally, the use of yogurt as well as probiotic drinks that have been enhanced with peels is another way that the food industry is examining the synergistic relationship between plants and microorganisms to enhance human gut health.

1. **Antioxidant Activity:** Due to its great antioxidant capacity, the crude extract of M. indica peels is a possible source of natural antioxidants. (4) The pectin obtained from star fruit has anti-microbial, anti-inflammatory, and anti-ulcer effects, whereas the pectin from Burmese grapes has antioxidant and anti-inflammatory qualities. (5) (6)

   Reactive oxygen species are created by normal cellular and metabolic functions, ionizing radiation, and xenobiotics. These substances are also the cause of a variety of chronic disorders, including cancer and cardiovascular problems. hydrogen, lipoperoxides, and superoxide radicals. The ability of ROS to harm pertinent and delicate biological substrates, such as DNA, RNA, proteins, and membrane lipids, determines how hazardous they are. In addition to hydrogen peroxide and free radicals, ROS also comprise superoxide radicals and lipoperoxides.

   The interior of the skin of the pomegranate is made up of a network of membranes that accounts for almost 26–30% of the weight of the entire fruit. Pomegranate peels also contain significant amounts of phenolic compounds, such as flavonoids (anthocyanins, catechins, and other complex flavonoids) and hydrolyzable tannins (punicalin, pedunculagin, punicalagin, gallic, and ellagic acid). Pomegranate peel (PoP) and juice contain high concentrations of these chemicals, which are responsible for 92% of the fruit's antioxidant action (Afaq et al., 2005; Negi et al., 2003; Zahin et al., 2010).

   In addition to having antibacterial activity against intestinal flora, particularly enteric pathogens including Escherichia coli, Salmonella spp., Shigella spp., and Vibrio cholerae, gallic acid, ellagic acid, and punicalagin also have free radical-scavenging capabilities. (Aviram et al., 2008, Lu et al., 2007, Pai et al., 2011, Taguri et al., 2004). Different cultures have extensively acknowledged PoP's healing potential. In Egyptian culture, pomegranate peel extract (PoPx) has been used to cure a number of common illnesses, including inflammation, diarrhea, intestinal worms, cough, and infertility. PoP's outstanding antioxidant capacity and robust therapeutic characteristics prompted the international scientific community to launch a significant study effort to further understand its impact on human health in the last 10 years. (Lansky and Newman, 2007).

   The active components of pomegranate extracts (PoMx) have been shown in several studies to have antimicrobial, antihelminthic, and antioxidant potential, suggesting their preventive and therapeutic role in gastro-mucosal injuries, cancer chemoprevention, ethanol- and acetone-induced ulceration, and diabetic oxidative damage. The mechanism of pomegranate peel phenolics' antibacterial activity includes the precipitation of membrane proteins, which causes microbial cell lysis. Due to its antibacterial and anti-mutagenic qualities, PoPx's ethnopharmacological profile makes it a valuable traditional asset. Furthermore, PoP's phytochemical content is sufficient for it to be effective without further enrichment with extracts from any other fruit component. (10)

2. **Anti-Microbial:** In 36 patients with HIV lipodystrophy, research investigations were conducted to assess the benefits of combining nutrition therapy and counseling with passion fruit peel flour. After 30 days, it was discovered that using passion fruit peel flour helped lower total cholesterol and triacylglycerides. After receiving a 90-day treatment with passion fruit peel flour, the blood of lipodystrophy patients had lower levels of LDL and triglycerides while having higher levels of HDL. (7)

   The methanolic and ethanolic extracts of pumpkin peel have antibacterial activity. Pectic polysaccharides from pumpkin peel were studied in relation to their effects on the evolution of human gut flora. (12) The pectic polysaccharide fractions shown growth-promoting activity for healthy intestinal bacteria such as B. bifidium, B. longum, and L. brevis while growth-retarding activity was observed for harmful intestinal bacteria such as E. coli and C. perfringins. They agreed that the pectic polysaccharides found in pumpkin peel had growth-promoting effects on the good bacteria in the stomach as well as glucose and bile acid-lowering effects, making them appropriate as a functional food component.

   Numerous citrus flavonoids, in particular naringenin, quercetin, sinensetin, and apigenin, were found to be powerful, non-specific inhibitors of AI-mediated cell-cell signaling in pathogenic bacteria.

   Active chemicals that fight germs locally without seriously harming surrounding tissues are known as antibacterial agents. The antibacterial activity of the citrus macroptera peel was strongest contrary to bacteria such as Bacillus spp. and E. coli, separately. (14)

3. **Anti-Cancerous:** The Punica granatum (P. granatum) fruit's skin is typically discarded, yet it really provides 30–40% of the fruit's protein. In human bladder cancer T24 cells, cervical cancer HeLa cells, prostate cancer cells, breast cancer cells, colon cancer cells, and thyroid cancer cells, P. granatum reportedly has potent anticancer capabilities. There is currently no information on the usage of P. granatum peel extract as a stabilizer for the synthesis of IONPs for the treatment of colon, breast, cervical, or lung cancer.

4. **Anti-Inflammatory:** Citrus reticulate dried citrus peel, also known as "chenpi," contains a complex blend of flavonoids and has a long history of usage in traditional medicine to treat a number of digestive ailments. We examined three traditional chenpi sources from California (USA), Guangxi, and Zhejiang with two "nchenpi" sources from Sichuan and Xinhui (China), which have higher nobiletin contents. The highest concentration of polymethoxylated flavones, as well as the best ability to neutralize free radicals like 2,2′-azobis-2-methyl-propanimidamide, dihydrochloride (AAPH), 2,2-diphenyl-1-pcrylhydrazyl (DPPH), and nitric oxide (NO), were found in Xinhui orange peel extract (OPE). Along with having more NO, iNOS, and COX-2 inhibitory action than a comparable flavonoid mixture (P 0.05), OPE also exhibited higher NO. Nobiletin is a useful chemical marker for evaluating the anti-inflammatory potential of OPE from various sources, in conclusion. Comparing "nchenpi" from Sichuan or Xinhui to traditional chenpi sources, the potential health advantages were potentially superior.

III. CONCLUSION

These are fresh, affordable, and natural sources of antioxidants that can be used to stave off ailments brought on by free radicals. The extensive content listed here covers the body of research on the use of fruit and vegetable peels in preventing and treating chronic inflammatory disorders. Fruit peel has been found to include long-lasting bioactive substances with a variety of biological potentials and nutritional benefits that can be utilised to create nutritious food products. This is a crucial first step in reducing food chain waste and a fresh approach to developing diversified and inventive food products, opening up a market for long-lasting and useful goods. As a result, it is now essential that sensory scientists, food technologists, and nutritionists work together to tackle the problem of creating more widely accepted and appetizing foods. Additionally, efforts must be made to comprehend the potential issue with food safety as well as customer attitudes around the use of fruit peels in food preparation, formulation, and its medicinal function.

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