Volume: 4 Issue: 5 Pages: 161-163

Rethinking Paan: Can Betel Quid Roughage Support Microbiome Health and Prevent Cancer

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Article Info.
E-ISSN: 2583-6528
Impact Factor (SJIF): 6.876
Peer Reviewed Journal
Available online:
www.alladvancejournal.com

Received: 21/April/2025
Accepted: 25/May/2025

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Abstract
Betel quid is made by placing certain spices and diced areca nut onto a betel leaf, and folding the leaf in order to create an envelope like quid. The quid is consumed either plain or in a sweetened form, the latter gaining its sweetness from the addition of crushed, sugared rose petals, much like rose jam. In the sweetened quid, the inclusion of rose jam (gulkand) has been shown to selectively suppress harmful gut bacteria while sparing beneficial strains such as Bifidobacterium and Lactobacillus. This prebiotic-like activity is attributed to hydrolyzable tannins like rugosin D and tellimagradin II. Chlorophyll present in betel leaf exhibits antioxidant and anticancer effects by neutralizing free radicals, minimizing DNA damage, and binding to carcinogens to reduce their uptake in the digestive tract. Additionally, a study investigated the impact of areca nut and its bioactive constituents on gut microbiota and lipid metabolism in mice fed a high-fat diet. Their findings showed that areca nut polyphenols promoted the growth of beneficial microbes such as Akkermansia and suppressed pathogenic ones like Ruminococcus. Thus, betel quid components lead to a healthy gut microbiome.

Keywords: Betel leaf, areca nut, paan quid, chlorophyll, munchie dessert, gut microbiome health

Introduction

Paan (Piper betel) is commonly consumed in India and other South Asian countries, by adding certain spices and folding the betel leaf to make a quid. Contrary to common perception, some components of betel quid, particularly rose petals, areca nut, and betel leaf chlorophyll, are beneficial for their anticarcinogenic activity and gut microbiome modulation [1]. In India, the use of betel leaves and areca nut are an inseparable part of Hindu religious rituals (pooja), wherein an intact betel nut (pongi phalam) is placed onto a betel leaf (tamboolam). Ancient Ayurvedic scriptures like the Charaka Samhita, Sushruta Samhita, and Ashtanga Samgraha advocate the use of betel leaf after bathing and meals [2]. They also recommend combining betel leaf with other ingredients such as slaked lime, catechu, clove, rose petal jam and areca nut, to make a quid [2]. Betel quid may be prepared either plain or sweetened, the latter taste being achieved by the addition of crushed and sweetened rose petals, similar to rose jam. Upon protracted chewing, the quid's components, including the diced areca nut, get pulverized and mixed with saliva to form a pulp, which is then swallowed. The rose jam (called gulkand) in sweetened betel quid has been found to selectively inhibit harmful gut bacteria without affecting beneficial ones (bifidobacteria and lactobacilli), acting in a similar fashion to prebiotics, due to their hydrolyzable tannins, namely rugosin D and tellimagradin II [3]. The chlorophyll in betel leaf acts as an antioxidant, antimutagen, and anticarcinogen, primarily by scavenging free radicals, reducing DNA damage, and forming complexes with carcinogens to reduce their absorption [4,5]. Research by Yi *et al*. explored how areca nut and its components influence gut health and lipid metabolism in a mouse model of high-fat diet-induced dyslipidemia [6]. Their analysis revealed that areca nut polyphenols increased populations of beneficial bacteria like Akkermansia, while reducing harmful Ruminococcus.

Modulatory Effects of Dietary Roughage from Betel Leaf, Areca Nut, and Rose Jam on Human Gut Microbiome

Rose (Rosa damascena) Petals

Kamijo *et al*. 2008, investigated the effects of crushed rose petals on the growth of 10 species of intestinal and pathogenic bacteria. Their results suggested that the soluble phyto-constituents in the rose petals suppressed the growth of four pathogenic intestinal bacteria in plate culture, without affecting the growth of beneficial bifidobacteria or lactobacilli [3]. The latter two genera of bacteria are known to enhance the human immune system and to produce short-chain fatty acids. This selective antibacterial activity of the pulverized petals on intestinal and pathogenic bacteria resembles that of prebiotics such as oligosaccharides and dietary fibre. The investigators proposed that the active constituents in rose petals responsible for this beneficial activity, were the hydrolyzable tannins, such as rugosin D and tellimagradin II.

Macromolecular polysaccharides, such as xyloglucans pectic polysaccharide and arabino-3,6-galactans, extracted from rose petals have been found to modulate the intestinal immune system activity through actions on Peyer's patch cells, and increase IL-6 production in murine macrophages. The carbohydrate fractions of the pectic polysaccharides mainly consist of galacturonic acid, arabinose and galactose, and the immunomodulating effect in mice intestine is presumably due to active carbohydrate structures such as the arabino-3,6-galactan present in rose petals [7].

Chlorophyll (from betel leaf)

In the human gut, the beneficial bacterial genera are Bifidobacterium and Lactobacillus these beneficial bacteria are known to support immune health and produce short-chain fatty acids. Recent investigations have found that spinach extract-high in chlorophyll-not only reduced body weight gain and chronic inflammation but also improved glucose tolerance in mice on a high-fat diet [1]. This extract also helped restore balance of gut microbiota disturbed by the high-fat diet. The primary component of betel quid, the betel leaf, is a rich source of chlorophyll-a group of pigments (including chlorophyll a, b, c, d, and e) with notable biological activities in humans. Chlorophyll has been shown to exhibit antioxidant, antimutagenic, and anticancer properties [4]. In animal studies Rao and colleagues found that betel leaf extract reduced the incidence of DMBA-induced mammary tumors in rats [8]. In rodent studies, chlorophyll has been shown to protect against aflatoxin-B1–induced carcinogenesis, improve metabolic markers, induce apoptosis in cancer cells, and alleviate gut dysbiosis [9].

Chlorophyll derivatives, like pheophorbide a and chlorophyllin (CHL), also show cancer-preventing properties by disrupting carcinogenic pathways, such as NF-κB and PI3K/Akt [10,11]. In fact, Chlorophyllin, the water-soluble derivative of chlorophyll, demonstrates robust antigenotoxic, antioxidant, and anticancer activities [10]. Zheng *et al*. examined the impact of orally administered chlorophyllin on gut microbiota. Their results showed that chlorophyllin rapidly adjusted the gut microbial balance-suppressing the phylum Firmicutes while promoting Bacteroidetes, and reduced inflammation and hepatic fibrosis [12].

Areca Nut (Areca catechu)

Studies indicate increased microbial diversity and beneficial changes in the gut microbiota of betel nut users [13,14]. Areca nut polyphenols boost beneficial bacteria like Akkermansia, reduce harmful bacteria (Ruminococcus), and help counteract high-fat diet-induced dyslipidemia by lowering lipid-related protein expressions [6].

Conclusion

Archaeological discoveries indicate that both the areca nut and betel leaf have been consumed by humans since ancient times. The earliest physical evidence of areca nut use comes from Spirit Cave in Thailand and Kuala Selingsing in Peninsular Malaysia, dating back to 10,000 years [15-19]. The earliest documented use of betel leaves in India dates back to around 400 BCE, with references appearing in the ancient Ayurvedic text Charaka Samhita [20]. The classical Ayurvedic texts praise the medicinal properties of betel leaf (BL), highlighting its particular value for heart health [21,22,23]. Several Paan constituents positively impact the gut microbiota. Rose petal jam possesses both antibacterial and prebiotic properties. A rodent study by Zhao *et al*. (2018) showed that areca nut enhances gut microbial diversity and abundance, regardless of its form [14]. Betel leaf's chlorophyll has been associated with antioxidant, antimutagenic, and anticancer activities, and may also alleviate gut dysbiosis, thereby supporting overall gut health [24].

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