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A REVIEW ON SYNERGISTIC EFFECTS OF PUMPKIN SEEDS AND GUAVA ON HUMAN HEALTH

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ABSTRACT
This review examines the nutritional and pharmacological benefits of pumpkin and guava, and their potential synergistic effects when combined. Pumpkin seeds exhibit anti-carcinogenic, anti-diabetic, anti-inflammatory, and anti-depressant properties. Guava, on the other hand, is rich in antioxidants, demonstrates anti-cancer activity, and supports immune function and wound healing. The combination of pumpkin and guava may enhance health outcomes through improved antioxidant defense, metabolic regulation, and overall well-being. Marketed formulations and emerging research highlight the promise of these natural pairings in developing new nutraceutical products and functional foods. Further research is warranted to validate these potential benefits and fully explore the health benefits of combining pumpkin and guava.

Keywords: Pumpkin seed, Guava, Anti-oxidant, Anti-diabetic, Protein, Vitamin

INTRODUCTION

PUMPKIN (*Cucurbita Pepo L)*:

Recent studies have shown that pumpkin seed oil can help manage hypertension, diabetes, and cancer[1]. Seeds and nuts are gaining popularity for their high nutraceutical and therapeutic benefits, thanks to their bioactive compounds, with key species including Cucurbita pepo, C. maxima, C. moschata, C. mixta, and C. stilbo.[2]. Pumpkin seeds are highly nutritious, offering protein, fats, fiber, minerals, and antioxidants. The term "pumpkin" comes from the Greek word "pepon," meaning "large melon." In India, pumpkins are called kashiphal or kaddu, and they are economically important and widely cultivated globally in various climates[3]. Pumpkin seed oil is versatile in cooking, while pumpkin seed butter is a popular peanut butter alternative[4]. Pumpkins vary in shape, size, and color based on type and climate. Their nutritious flesh and protein-rich seeds have spurred growing interest in pumpkins and their products across food, agriculture, pharmaceuticals, and animal feed sectors[5]. Pumpkin seeds, or Pepitas, are small, flat, green, and edible, with a chewy texture and nutty flavor; they typically have a white husk, though some varieties are husk-free[6]. Pumpkin fruit is packed with bioactive compounds like carotenoids, phenolic acids, and flavonols, and is a rich source of macronutrients and minerals. Its low glycemic index, due to its fiber content, adds to its nutritional benefits[7].

Geographical Source
Pumpkin Seed Originally from Mexico and widely grown in India, Africa, Latin America, Southern Asia, and the United State[8].

Botanical description
Understanding the botany of various Cucurbita species helps us understand their differences and how to handle their by-products. It gives us important information about the plant's structure and function, which is essential for understanding its seeds.

Seeds:
The seeds are large, flat, and oval with a pointed tip, weighing 50 to 250 mg. They germinate best at 25-30 ºC and slow down below 15 ºC, with the embryo filling the seed coat and nutrients stored in the cotyledons (Fig-1)[9].

[Fig-1 Pumpkin Seed]

Species of *Cucurbita*[10]
The five main domesticated Cucurbita species are C. pepo, C. moschata, C. mixta, C. maxima, and C. ficifolia, selected by Native Americans before European contact (Whitaker and Bemis, 1976).

I. ***Cucurbita argyrosperma*** : Also known as Cucurbita mixta.
II. ***Cucurbita ficifolia*** **:** Also known as Figleaf Gourd, Chilacayote**.**
III. ***Cucurbita maxima*****:** Also known as Giant Pumpkin**.**
IV. ***Cucurbita moschata*****:** also known as butternut squash or golden cushaw.
V. ***Cucurbita pepo*****:** also known as pumpkins, summer squash and acorn squash.

Taxonomical Classification [11]
Kingdom: Plantae (also known as Plants)
Division: Tracheophyta
Class: Magnoliopsida
Order: Cucurbitales
Family: Cucurbitaceae
Genus: Cucurbita
Species: *C.maxima, C.pepo, C.moschata, C.palmata, C.ficifolia*

Physiochemistry of Pumpkin Seed
Pumpkin seeds are prized for their high protein, linoleic acid, and essential amino acids, and are rich in key minerals like potassium(K), chromium(Cr), sodium(Na), magnesium(Mg), zinc(Zn), copper(Cu), molybdenum(Mo), and selenium(Se)(Table 1,2,3)[12].

Nutritional Composition Of Pumpkin Fruit and Seed[13] **[Table-1]**

Nutrient	**Pumpkin Fruit(Value/100gm)**	**Pumpkin Seed (Value/32.25gm)**
Energy	109 kJ	Not Reported
Water	91.6 g	1.69 g

Fat	0.1 g	15.82 g
Protein	1.0 g	9.75 g
Ash	0.8 g	1.54 g
Dietary Fiber	0.5 g	1.94 g
Carbohydrates	6.5 g	3.45 g

Mineral Composition Of Pumpkin Fruit and Seed[13] **[Table-2]**

Nutrient	Pumpkin Fruit (mg/100gm)	Pumpkin Seed (mg/32.25gm)
Calcium	21	14.84
Iron	0.8	2.84
Magnesium	12	190.92
Phosphorous	44	397.64
Potassium	340	260.90
Sodium	1.0	2.26
Zinc	0.32	2.52
Copper	0.127	0.43
Manganese	0.127	1.47

Vitamin Composition Of Pumpkin Fruit and Seed[13] **[Table-3]**

Nutrient	Pumpkin Fruit (mg/100gm)	Pumpkin Seed (mg/100gm)
Vitamin A	0.426	0.019
Vitamin C	9.0	0.3
Vitamin B1	0.05	0.034
Vitamin B2	0.11	0.052
Vitamin B3	0.6	0.286
Vitamin B5	0.298	0.056
Vitamin B6	0.061	0.037
Vitamin B9	0.016	0.009
Vitamin E	1.06	Not Reported
Vitamin K	0.001	Not Reported

Therapeutic And Health Promoting Properties of Pumpkin Seed[14-15]

I. **Anti-carcinogenic effect**: Cancer is a major health issue, prompting efforts in prevention and treatment. Eating vegetables, fruits, and pumpkin seeds may lower the risk of cancers like stomach, breast, lung, and colon. Pumpkin seed oil and fruits might also help prevent prostate cancer.
II. **Anti-diabetic activity**: Diabetes is becoming more common and expensive, so cheaper treatments like pumpkin, which might help manage blood sugar, are being explored. But more research is needed to be sure it works.
III. **Antimicrobial and Antifungal effects**: Pumpkin seed oil also has antimicrobial and antifungal properties. It can fight a variety of bacteria and is effective against fungi like Rhodotorula rubra and Candida albicans at certain concentrations.
IV. **Anti-inflammatory effects**: Pumpkin-fortified foods contain anti-inflammatory compounds that might help with arthritis. Pumpkin seed oil can ease arthritis in rats, similar to the drug indomethacin. Beta-carotene in pumpkin seeds also helps reduce joint inflammation.
V. **Anti-depressant effect:** Pumpkin seeds may help alleviate depression due to their high content of antidepressant compounds and their ability to boost serotonin production, as seen in rat studies**.**
VI. **Role in breast cancer**: Phytoestrogens impact hormone-related tumors in various ways. Research on rats indicates that pumpkin seed extract can increase estradiol and change hormone receptors in breast cancer cells, suggesting it might aid in treating and preventing breast cancer, especially in MCF7(Michigan Cancer Foundation-7) cells.

VII. Anti-oxidant activity: Pumpkin extracts, packed with antioxidants like selenium, zinc, and vitamin E, help reduce oxidative stress and protect against diseases like diabetes and cancer, as shown in studies with mice**.**

Marketed Formulation

There are various formulations available in the market:

Sr.no	Product name	Company name	Use
1	Pumkin Seed Oil	essancia-NATURALLY IN EVERY DROP	Natural Hair Growth Booster, Skin Moisturizer, Hair & Scalp Nourishment.
2	Pumpkin Seed Butter	BRM Herbals	Moisturization and Nourishment, Candle & Soap making.
3	Pumpkin Seed Scrub	NIGHT BLUE NATURALS	Blackhead Removal, Mark and Spot Removal, Skin Brightening, Tan Removal, Remove Dead Skin Cell.
4	Pumpkin Seed Oil	HESTHETIC	Cooking, Baking, Smoothies
5	Raw Pumpkin Seed	NutrOVally	Good for Heart, Bone Strong, Support Immunity System, Maintain Blood Sugar Level.
6	Pumpkin Seed Gummies	CERES NATURE	Improve Brain Function, Promote Hair Growth and Healthy Skin.

Research Synergistic Effect of Pumpkin

A. Chen X, et al., has concluded that, Pumpkin polysaccharides with puerarin (Indian kudzu) lowers blood sugar, enhances glucose control, and reduces insulin resistance more effectively for Type-2 Diabetes Mellitus mice [16].

B. Li T, et al., has concluded that, Research on pumpkin seed extract with taeniasis treatment shows potential, though praziquantel and niclosamide are currently the main treatments for this tapeworm infection [17].

C. Park HJ, et al., has concluded that, juice from pear, hemp seeds, and pumpkin seeds effectively blocks ACE, boosts nitric oxide levels, and offers strong antioxidant benefits[18].

D. Shalan NA, et al., has concluded that, Combining black mulberry extract, sunflower seeds, and pumpkin seeds has been shown to improve memory in healthy young adults, regardless of exercise, for the first time[19].

E. Arzoo SH, et al., has concluded that, Combining Gymnadenia orchidis root extract (Salep) with pumpkin seed powder might manage diabetes in Streptozotocin-treated mice and could be a better type-2 diabetes option[20].

GUAVA (*Psidium Guajava L.)*:

Guava, or tropical apple, grows well in sunny, warm regions of India, handling dry conditions but thriving with regular watering [21]. Guavas are valued for their sweet-tangy flavor, rich nutrients, and medicinal benefits, earning them the title of "magical" fruit[22]. Guava is called the "Queen of Fruits" for its rich nutrients, high protein and fiber, no cholesterol, and dense vitamins and minerals[23]. Guava leaves may help with cancer prevention, blood pressure control, diarrhea, weight loss, skin improvement, and relief from coughs, colds, constipation, dysentery, and scurvy [24]. Guava is a super fruit due to its high phenol and antioxidant content, and processed products like jams and beverages are popular despite fresh guava being less available [25].The plant is called "Guava" in English, "guayabo" in Spanish, "goyave" in French, "guyaba" in Dutch, "goiaba" in Portuguese, "pichi" in Mexico, "Pear" in Arabic, "Draksa" in Sanskrit, "Amaratafalam" in Perala, "Jamrukh" in Gujarat, and "Amrood" in Hindi. [26-27]. Guavas are fat- and cholesterol-free, high in potassium and vitamin A, and

contain a variety of beneficial compounds like flavonoids, steroids, and carbohydrates[28]. Guava, or Psidium guajava L., has about 150 species globally, with common, cattley, pear, and apple guavas being the most well-known[29]. Guava's nutrition, aroma, and flavor make it perfect for processed foods and "super-fruits" [30].

Geographical Source

Guava originally native to tropical America, it is now extensively grown in other tropical regions including India, China, Indonesia, Pakistan, Bangladesh, and South America[31].

Botanical Description

P. guajava is a sizable evergreen shrub or small tree that can grow up to 15 meters tall. Originally from Mexico and Central America, it is now found throughout warm areas of tropical America and the West Indies. Currently, it is grown from Asia to the west coast of Africa, with different varieties having been introduced from the United States over the last 300 years[32].

Morphology

Understanding guava morphology includes its roots, stem, tree size, leaves, flowers, and fruits. The guava tree, usually a small to medium shrub or tree, grows 2 to 7 meters tall, with multiple branches, smooth copper-colored bark that peels to reveal greenish skin, and a trunk that can reach 25 cm in diameter.

Fruits:

Guava fruit, 5–10 cm in diameter and weighing 50–200 g, has a thin, light yellow skin with a touch of pink, and contains a granular, juicy mesocarp and stony seeds. It has a short shelf life of 3–5 days at room temperature [33](Fig-2).

[Fig-2Guava Fruit]

Taxonomy Classification[34]

Kingdom: Plantae
Class: magnoliopsida
Order: myrtales
Family: myrtaceae
Genus: psidium
Species**:** Psidium guajava

Nutritional Value of Guava[35] **[Table-4]**

Nutrients/Minerals	Value/100gm	Benefits
Water	80.80 gm	Helps regulate and maintain body temperature.
Energy	68 Kcal	Supports daily activities and overall energy levels.
Protein	2.55 gm	Essential for growth, development, and cell repair.
Total lipid (fat)	0.95 gm	Provides and stores energy, and spares protein for its functions.
Carbohydrate	14.32 gm	Provides energy and allows proteins and fats to focus on other functions.
Fiber, total dietary	5.4 gm	Promotes a healthy digestive system.
Calcium	18 mg	Supports bone strength and helps build teeth.
Iron	0.26 mg	Essential for proper haemoglobin function.
Zinc	0.23 mg	Essential for wound healing
Potassium	417 mg	Enhances muscle strength and helps maintain blood pressure.

Vitamin C	228.3 mg	Promotes collagen production and enhances the absorption of iron.
Vitamin K	2.6 mg	Aids in blood clotting.
Vitamin E	0.73 mg	Defends cells against damage.

Medicinal Value of Guava[36-37]

I. **Act as anti-carcinogenic effect:** Guava fights cancer with antioxidants like lycopene, quercetin, and vitamin C, which protect against free radicals and lower the risk of prostate and breast cancer.
II. **Diabetes-Friendly:** Guava is good for diabetes as it contains only 5 grams of sugar and lots of fiber, which helps manage blood sugar. Its low glycemic index keeps sugar levels stable.
III. **Healthy for the Brain:** Guavas contain vitamins B3 and B6, which boost brain blood flow, improve thinking, and help calm nerves**.**
IV. **Beats tooth pain:** Guava leaf juice, made from tender leaves, has anti-inflammatory and antibacterial properties that help treat mouth ulcers, sore gums, toothaches, and dental sensitivity when used as a mouthwash.
V. **Booster of Immunity:**Guava has four times more vitamin C than oranges, boosting immunity, fighting illness, shortening colds, and enough vitamin A to support eye health**.**
VI. **Treats indigestion:** One guava provides 12% of your daily fiber, supporting digestion, while guava leaf extract and seeds help maintain gut health and prevent constipation.
VII. **Anti-Aging Features:** Guavas, rich in vitamins A, C, and antioxidants like carotene and lycopene, help prevent wrinkles, and guava leaves are used in premium skincare for their antioxidant benefits.
VIII. **Anti-Cancer Activity:** Lycopene in guava, especially in the red part, helps prevent and treat cancers like breast and prostate by neutralizing free radicals, while carotene may help prevent lung and mouth cancers.
IX. **Wound Healing:** Guava leaves, rich in tannins and flavonoids, help wounds heal faster. A simple ointment made by mixing crushed leaves with oil and wax outperforms many commercial products.
X. **Antidiarrheal:** Drinking boiled guava leaf water on an empty stomach helps with diarrhea due to its antibacterial and flavonoid content, while guava bark is effective for children. Guava leaf tea also aids bowel movements.

Different Compound And Their Uses In Guava Plant Part[38]**[Table-5]**

NO.	Plant part	Compound	Traditional Use
1	Seed	Glycosides, carotenoids, phenolic compounds	Exhibits antimicrobial properties.
2	Bark	Phenolic compounds	Shows potent antibacterial effects, relieves stomach pain, and offers antidiarrheal benefits.
3	Leaves	Phenolic compounds, flavonoids, gallic acid, catechin, epicatechin, rutin, naringenin, kaempferol	Provides antioxidant, anti-inflammatory, antispasmodic, anticancer, antimicrobial, anticonservative, and neuropathic effects.
4	Skin	Phenolic compounds	Enhances food absorption.
5	Pulp	Ascorbic acid , carotenoids (lycopene, β-carotene, β-cryptoxanthin)	Provides antioxidant and antihyperglycemic effects.

Marketed Formulations

There are various formulations available in the market:

Sr.no	Product name	Company name	Use
1	Guava Glow Juicy Cleanser Face Wash and Serum	PLiX	Bright Skin, Promotes Hydration, Reduced Skin Inflammation.
2	Guava Leaves Powder	AYURGYAN	Hair-fall Treatment, Hair-growth Treatment, Scalp Treatment, Hair Conditioning Treatment, Hair Repair Treatment.
3	Pink Guava Face Mask	Pure Sense	skin tone and improves skin texture, face mask for bright, glowing and healthy looking Skin, Purifies and detoxifies skin.
4	Guava Jam	DIABLISS	support diabetes management and help maintain optimal blood glucose levels.
5	Guava Powder	SAIPRO Nature and Future	Immunity Booster.

Research Synergistic Effect of Guava

A. **Mitra S, et al.,** has conclude that, Guava leaf extract combined with antimicrobial drugs was tested against E. coli, revealing the best synergy with the antibiotic ofloxacin[39].

B. **Amadi LO, et al.,** has concluded that, Guava leaf extracts combined with alum effectively targeted S. aureus, B. subtilis, E. coli, and P. aeruginosa, suggesting potential as a new infection treatment [40].

C. Jyoti A, et al., has concluded that, Combining guava leaf extract with zinc oxide nanoparticles may effectively treat drug-resistant ETEC((Enterotoxigenic Escherichia coli) infections found in Gwalior's water [41].

D. Mounica M, et al., has concluded that, Guava leaf and Ficus hispida extracts both showed strong anti-diabetic effects in rats, with their combination enhancing efficacy, indicating potential as oral diabetes treatments[42].

E. Bala I, et al., has concluded that, Eucalyptus camaldulensis and Psidium guajava leaves might fight bacteria, but their active chemicals need separate testing[43].

CONCLUSION

The exploration of various fruit and ingredient combinations with guava and pumpkin underscores the potential for significant synergistic effects that surpass the benefits offered by individual components. The review highlights how these combinations can lead to enhanced health outcomes, such as improved antioxidant defence, better metabolic regulation, and overall well-being. The results suggest that these natural pairings could be effectively utilized in the creation of new nutraceutical products and functional foods. Further research is essential to confirm these synergistic effects and to develop practical applications that harness the full potential of these combinations.

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