Plant Archives Vol. 18 No. 2, 2018 pp. 2545-2552 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

EXPLORING NUTRITIONAL VALUES, HEALTH CLAIMS AND ALLERGIES ASSOCIATED WITH KIWIFRUIT CONSUMPTION

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Abstract

Fruit consumption in India is rising due to the health awareness and many exotic fruits are showing their presence in Indian fruit market. Kiwifruit being one of them has attained its place initially in fruit markets at big cities, malls and now it has infiltrated in district and tehsil level fruit markets. Kiwifruit is mainly consumed as a novelty fruit without knowing its true nutritional values. As a part of marketing strategy they are labeled with various health benefits. Present study is an attempt to explore the available information related to Kiwifruit with reference to its nutrient content as well as health claims and the allergies associated with its consumption.

Key words : Kiwi Fruit, Nutritional value, Health benefits, Allergy

Introduction

Kiwifruit is a new arrival in India and nowadays, we sight kiwifruit everywhere in Indian fruit markets. There is rising awareness among Indian population about their looks, their health and so about their diet. Consciousness about anti-aging and antioxidants, have triggered the fruit consumption. The options are searched for fruits providing more anti oxidants, fruits beneficial for preventing heart diseases, cholesterol dissolving, blood pressure regulators, kidney diseases and various cancers. As soon as the new fruit arrives in the market, it is labeled with some disease preventive or curative property. Every fruit is rich in some or other vitamins and minerals. Eating fruits is beneficial for human health. It is universally accepted understanding. kiwifruit is no exception to it. Since, it is a new arrival in Indian scenario, very less information is available about its nutritional values, medicinal and therapeutic values and unfortunately the allergies associated with its consumption.

Kiwifruit is a native of south-western China where it is found in wild form. Therefore, the fruit was called Chinese gooseberry. From its native place China, the fruit the fruit was spreaded to Europe, USA and New Zealand. In New Zealand, it got popular and domesticated and spreaded to different parts of the world. In New Zealand, it was renamed as Kiwifruit. Today, it is mainly grown in New Zealand, Italy, USA, China, Japan, Australia, France, Pakistan, Iran, Kashmir, Chile and Spain. In India Kiwi fruit is mainly grown in the mid hills of Himachal Pradesh, Uttar Pradesh, J&K, Sikkim, Meghalaya, Arunachal Pradesh, Karnataka, Uttarakhand and Kerala.

It belongs to the genus Actinidia with 50 species and 100 taxa. Out of many species, Actinidia chinensis and Actinidia deliciosa are the two major species with commercial importance. *Actinidia deliciosa* is green Kiwi fruits while *Actinidia chinensis* is golden Kiwifruit. Kiwi is a dioecious plant bearing male and female flowers separately. Various varieties grown commercially are Hayward, Abbot, Allison, Bruno and Monty. Tomuri, Matua and Qinmei are staminate cultivars. Variety Bruno contains highest ascorbic acid and titrable acidity. Hayward is also high in ascorbic acid and sugar with a biennial bearing tendancy. Cultivar Monty has higher acidity and medium sugar content.

It is a woody vine with deciduous nature. The vine is vigorous and bears fruits for 50 years or even more with trunk around 8 inches in diameter at maturity and bearing determinate as well as indeterminate shoots at maturity. The indeterminate shoots usually grow 10-15 feet turning into tendrils towards the terminal end. Determinate shoots

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remain short with 3-6 leaves bearing flower buds next year. Kiwifruit Leaves are papery, large around 8 inch in diameter, broad obovate, petioled, with entire margins, deep green ventral surface, pale green dorsal surface with pale brown stellate hair. Male plants have smaller leaf size compared to that of the female plants. Kiwifruit flower is a cyme having 5 sepals, growing distinctly or connately with 5 petals white or green in colour, many stamens with yellow anthers, spherical shaped superior ovary and filiform style. Flowers are borne on current season's growth. Female flowers are larger with smaller anthers; shorter filament and blossom later compared to the male flowers, Pollens of the female flower are infertile. Male plants flower earlier to female plants. Male flowers have fertile pollens. While planting Kiwifruit, female and male plant ratio is maintained at 8:1 or 6:1. The flowering occurs from May to June, and the fruit matures during August to October.

Botanically kiwifruit is a berry type with large number of seeds embedded in the pulp. The shape of the fruit is elliptic or obovate. Fruit peel or the exocarp is green or greenish brown in immature fruit. At the ripening stage fruit peel turns to reddish brown (hispid). The fruit pulp is greenish due to chlorophyll with whitish central axis and 1-3 rows of small black seeds radiating around it. The fruit pulp looks watery or translucent. Fruit drop is generally not observed in Kiwifruit.

Nutritional value of kiwifruit

Ripe kiwifruit is eaten as fresh fruit. It is rich in vitamin C and minerals like calcium, magnesium, potassium and fiber. It is considered as a low calorie and fat free fruit. Processed kiwifruit products like juice, wine, canned kiwifruit, beverages, vinegar, ice cream using kiwifruit are used in human diet.

According to the USDA nutrient database (Release 28, 2018), 100 g of edible kiwifruit has the following nutritional value:

Total antioxidant concentrations of kiwifruit (*Actinida chinensis)* is 1.29 mmol/100 g (Halvorsen *et al.*, 2002). These antioxidants include tocopherol, vitamin C, carotene lutein, zeaxanthin, lycopene, polyphenolic acids, sulfides, flavonoidsan, lignans, etc. Various workers have reported antioxidant capacity of kiwifruit (Hunter *et al*., 2011; D'evoli *et al*., 2015)

Kiwifruit seed oil

Kiwifruit contains numerous small black seeds embedded in the pulp. These seeds though present in a very small quantity per fruit, are very nutritive. Oil extracted from Kiwi seed is the best source of natural unsaturated fatty acids being abundant of lonoleic acid, α-linolenic acid and other unsaturated fatty-acids. Kiwi seed oil is useful with the functions of adjusting HDL, anti-oxidation, putting off senescence, preventing coronary heart disease, gout and etc. (Li *et al*., 2005).

Table 1: Nutritional composition of raw green and raw gold kiwifruit

Sr. No.	Nutrient	Value per 100 g	
		Green	Gold
	Proximates		
1	Water (g)	83.07	82.44
2	Energy (kcal)	61	63
3	Protein (g)	1.14	1.02
4	Total lipid (fat) (g)	0.52	0.28
5	Carbohydrate, by difference (g)	14.66	15.79
6	Fiber, total dietary (g)	3.0	1.4
7	Sugars, total (g)	8.99	12.30
	Minerals		
8	Calcium, Ca (mg)	34	17
9	Iron, Fe (mg)	0.31	0.21
10	Magnesium, Mg (mg)	17	12
11	Phosphorus, P (mg)	34	25
12	Potassium, K (mg)	312	315
13	Sodium, Na (mg)	3	3
14	Zinc, Zn (mg)	0.14	0.08
	Vitamins		
15	Vitamin C, total ascorbic acid (mg)	92.7	161.3
16	Thiamin (mg)	0.027	0.000
17	Riboflavin (mg)	0.025	0.074
18	Niacin (mg)	0.341	0.231
19	Vitamin B-6 (mg)	0.063	0.079
20	Folate, DFE (µg)	25	31
21	Vitamin B-12 (µg)	0	0.08
22	Vitamin A, RAE (µg)	4	1
23	Vitamin A, IU (IU)	87	23
24	Vitamin E (alpha-tocopherol) (mg)	1.46	1.40
25	Vitamin D (D2 + D3) (µg)	0	0
26	Vitamin D (IU)	0	0
27	Vitamin K (phylloquinone) (µg)	40.3	6.1
	Lipids		
28	Fatty acids, total saturated (g)	0.029	0.065
29	Fatty acids, total monoun-saturated (g)	0.047	0.023
30	Fatty acids, total polyunsaturated	0.287	0.111
31	Fatty acids, total trans (g)	0	0
32	Cholesterol (mg)	0	0
	Other		
33	Caffeine (mg)	0	0

Source : https://ndb.nal.usda.gov/ndb/foods/show/2253

Major kiwifruit constituents and their role

Vitamin A

Vitamin A is fat soluble and can be stored in liver. It

produces pigments in the retina. It is required mainly for the normal functioning of visual system, skin grow and repair, healthy teeth, reproduction and immune function**.** Kiwifruit is rich in beta carotinoides that are precursors of vitamin A. Beta carotenoides are antioxidents that contribute to antiaging process and reduce the risk of cancer.

Vitamin C

Vitamin C has antioxidant, anticarcinogenic and immune regulating properties. Vitamin C forms important protein i. e. collagen which is used to make skin, tendons, ligaments and blood vessels. It also helps in healing the wounds, repairing and maintaining cartilage, bones and teeth. It also helps in absorption of iron. Human body cannot prepare and even store vitamin C. Therefore, adding through daily diet is the only way for fulfilling vitamin C requirement of human body. Kiwifruit contains 92.7 mg of vitamin C per 100 g of fruit pulp. Vitamin C content in kiwifruit varies with variety (Du *et al*., 2009; Latocha *et al*., 2010) and maturity stage (Lee and Kader, 2000). Efforts were made by Carr *et al*. 2012 to determine vitamin C uptake after consuming kiwifruit concluding kiwifruit as an excellent source of vitamin C in humans.

Vitamin E

Vitamin E is fat soluble. It is important in the formation of blood cells, widens the blood vessels and prevents blood clotting and helps body use vitamin K, keeps immune system strong. It is antioxidant and antiaging substance. Kiwifruit contains higher amount of vitamin E (Ferguson and Ferguson, 2003).

Vitamin K

Vitamin K is fat soluble**.** It plays essential role in blood clotting, transfer of calcium through the body, bone growth and development and prevents heart diseases, reduces the risk of osteoporosis.

Folate

Folate is vitamin B9. It is water soluble and body cannot store it. Therefore, adding through daily diet is the only way of supplying folate to human body. It is vital for making red blood cells, synthesis and repair of DNA and RNA. It helps to produce healthy red blood cells and prevents anemia. Ferguson and Ferguson, 2003 had earlier mentioned kiwifruit as a rich source of folates.

Potassium

Potassium in human body regulates the fluid balance, helps in activating nerve impulses thereby helps regulating muscle and heart contractions**.** Potassium rich diet may reduce blood pressure; prevent strokes, kidney stones and osteoporosis.

Phosporus

Phosphorous in human body helps in building strong bones and teeth, muscle contraction, normal heartbeats and nerve signaling. It filters waste from kidneys and repairs tissue and cells.

Calcium

Calcium helps to form and maintain healthy teeth and bones. It also plays key role in cell signaling, blood clotting, muscle contraction and nerve function.

Magnesium

Magnesium plays essential role in maintaining normal nerve and muscle function, strong bones, supports a healthy immune system, keeps the heart beat steady regulating blood pressure . It also helps in regulating blood glucose levels.

Fibre

Fibre intake in human body helps digestion and gastrointestinal system, lowers cholesterol, regulates blood sugar and help against diabetes and reduces the risk of heart disease. It also helps prevent constipation and lowers the risk of colorectal cancer.

Actinidin

Actinidin is a type of cysteine protease enzyme found in kiwifruit and helps in digestion of variety of food proteins.

Other bioactive compounds

Various organic acids like citric acid, malic, quinic, gallic, ascorbic and oxalic acids are considered present in Kiwifruit. These acids either act as energy source for living cells or as an antioxidant preventing degenerative process in living cells. Nishiyama, 2007 quantified the oxalate content in kiwifruit and reported that it is only 1–10% of the oxalate content of spinach. Nishiyama *et al*. (2008) quantified citric, quinic, and malic acids in Kiwifruit.

Plant pigments

Kiwifruit contains pigments like carotenoids and chlorophylls and anthocyanins. The carotenoids include beta-carotene, lutein, violaxanthin, and 9'-cis-neoxanthin (Cano, 1991; McGhie and Aing, 2002; Nishiyama *et al*., 2005). Kiwifruit is the richest source of lutein (Nishiyama *et al*., 2005) which is a carotenoid that is highly concentrated in the macula of the eye and is associated with lowering risk of cataracts.

Kiwifruit contains chlorophylls a and b mostly in raw fruits with exception of 'green' Kiwifruit (Nishiyama *et*

al., 2005). Some kiwifruits also contain anthocyanins. But considering the significantly low concentrations of total anthocyanins, Montefiori *et al*. (2005) had mentioned it as only a colouring agent and not sufficient to increase the antioxidant capacity of kiwifruit.

Other components

Kiwifruit also contains a good amount of *Myo*-inositol (Nishiyama *et al*., 2008) which is a component of vitamin B complex and is considered anticancerous (Shi *et al*., 2006; Vucenik and Shamsuddin, 2006). A. arguta varieties have the highest concentrations of myo-inositol (Nishiyama *et al*., 2008) making it richest natural dietary sources of myo-inositol.

Kiwifruit contains various amino acids and amines like arginine, glutamine and peptides like glutathione (MacRae and Redgwell, 1992). Glutathione is an antioxidant present in kiwifruit not only preventing oxidative damage of cells but also helps to keep vitamins C and E in their active form, regenerating their antioxidant capacities.

Health benefit claims

Several health benefits like, assisting in easy digestion, possessing anti-hyperglycemic activity, improving plasma lipid profiles, antioxidant activity, natural blood thinner boosting heart health, immune-stimulatory activity have been assumed to be associated with kiwifruit consumption.

Cardiovascular protective properties

The cardiovascular protective properties potential of kiwifruit may be due to its rich content of bioactive material like vitamin C, carotenoids and polyphenols or flavonoids. Motohashi *et al*., 2002 demonstrated the separation of various valuable bioactive materials in Kiwi gold fruits extract. Jung *et al*. (2005) analyzed the antioxidative, antihypertensive, hypocholesterolemic, and fibrinolytic activities of kiwifruit *in vitro* emphasizing the role of bioactive material in cardiovascular protection. Earlier in 2004, A.K. Duttaroy (Duttaroy and Jørgensen, 2004) confirmed the kiwifruit potential of inhibiting platelet aggregation induced by collagen and ADP in human and effectiveness in lowering blood triglycerides levels suggesting its prophylactic and therapeutic benefit in preventing and halting pathological processes that lead to CVD. Later in 2013, A.K. Duttaroy (Duttaroy, 2013) suggested that kiwifruit may provide a new dietary means as part of a preventive or therapeutic strategy to favorably modify cardiovascular risk factors.

Bowel function

There is an opinion that kiwifruit has laxative properties and it is a good natural laxative for elderly people who face slow bowel movement leading to constant constipation. Rush *et al*., 2002 highlited the importance of kiwifruit fiber content in improving laxation for elderly individuals who are otherwise healthy. Their study provided evidence of the kiwifruit potential for improvement in bowel function. Chan *et al*., 2007 confirmed effectivity of dietary kiwifruit fiber intake in relieving chronic constipation in Chinese population. Chang *et al*. 2010 suggested effective use of kiwifruit consumption to improve the bowel function in adults diagnosed with Irritable Bowel Syndrom**.** Chang *et al*., 2010 suggested that kiwifruit consumption for 4 weeks shortens colon transit time, increases defecation frequency, and improves bowel function in adults diagnosed with IBS/C. The role of Actinidin in kiwifruit in enhancing the protein digestion in the small intestine was confirmed and highlighted (Kaur *et al*., 2010; Kaur and Boland, 2013).

Ciacci *et al*., 2014 reported the first evidence supporting a possible correlation between some beneficial effects of kiwifruit and a specific protein molecule rather than generic nutrients. They investigated the Kissper (a kiwifruit peptide) influence on intestinal inflammation. Ansell *et al*., 2015 clinically demonstrated kiwifruit consumption leading to meaningful increases in bowel movements in healthy individuals.

Antioxidant properties

The antioxidant properties of kiwifruit may be attributed to its high vitamin C, vitamin E content, phenolics and carotenoides. Kiwifruit consumption is suggested for anti aging effect owing to its antioxidant properties.

Hunter *et al*., 2011 studied the antioxidant properties of kiwifruit summarizing it as a 'naturally protective' fruit involving in modulating immune responses in a positive way. Iwasawa *et al*., 2011 reported inhibition of oxidation of biological substances in the human body owing to stronger anti-oxidant effects of kiwifruit compared to orange and grapefruit. Bursal and Gülçin, 2011 proved high antioxidant properties in kiwifruit suggesting its use as a source of natural antioxidents and its use in diet and food supplement. Significant varietal difference in contents of the bioactive compounds and the level of antioxidant capacities in kiwifruit was also observed (Park *et al*., 2014). Leontowicz *et al*., 2016 reported high bioactivity and nutritional value of the fruits of *A. arguta* called as hardy Kiwi.

Renal function

Mahmoud and Farag, 2017 investigated the possible prophylactic and therapeutic effects of kiwifruit on the

Table 2 : Major kiwifruit components in comparison to other common fruits – Nutritional value per 100 g

Fruits/ Nutrient Content	Carbo-hydrates (gm)	Proteins (gm)	Fats (gm)	Fibre (gm)	Folate (µg)	B complex excluding folates	Vitamin A (IU) (mg)	Vitamin C (mg)	Vitamin E (mg)	Vitamin K (µg)	Potas-sium (mg)	Phosp-orus (mg)	Calcium (mg)	Magne-sium (mg)	Carote-noides (µg)	Total antioxidant value (mM TE/100 g)	Glycemic Index
Gold Kiwifruit	**14.66**	**1**	**0.52**	**3.8**	**25**	**0.393**	**87**	**92.7**	**1.46**	**40.3**	**312**	**-**	**34**	**17**	**174**	**1111**	**50**
Mango raw	17	0.5	0.27	1.80	14	0.993	765	27.7	1.12	4.2	156	-	10	9	473	-	49
Banana	22.84	1.09	0.33	2.60	20	1.47	64	8.7	0.10	0.5	358	22	5	27	73	-	62
Guava	14.3	2.55	0.95	5.4	49	1.752	624	228	0.73	2.6	-	11	18	22	5578	-	68
Grapes	18	0.72	0.16	0.9	2	0.463	66	10.8	0.19	14.6	191	-	10	7	102	-	69
Sapota	19.9	0.44	1.10	5.3	14	0.567	60	14.7	-	-	193	12	21	12	-	-	83
Papaya	10.82	0.47	0.26	1.70	37	0.644	950	60.9	0.30	2.6	182	10	20	21	1112	-	43
Pineapple	13.52	0.54	0.12	1.40	18	0.709	58	47.8	0.02	0.07	109	8	13	12	35	-	50
Pomegranate	18.70	1.67	1.17	4	38	0.556	0	10.2	0.60	16.4	236	36	10	12	0	2341	83
Jackfruit	23.5	1.72	0.64	1.5	24	1.409	110	13.7	0.34	-	303	36	34	37	223	-	95
Fig	19.18	0.75	0.30	2.9	6	0.923	142	2	0.11	4.7	232	-	35	17	94	3200	74
Lemon	9.32	1.10	0.30	2.80	11	0.39	22	53	0.15	0	138	-	26	8	35	1225	29
Oranges	11.89	0.94	0.30	2.50	39	0.714	230	48.5	-	-	179	-	40	10	-	1819	49
Mandarines	13.34	0.81	0.31	1.8	16	0.764	681	26.7	0.20	0	166	-	37	12	801	-	53
Strawberry	7.7	0.67	0.30	2.0	24	0.58	12	58.8	0.29	2.2	153	-	16	13	33	3577	32
Watermelon	7.6	0.6	0.15	0.4	3	0.477	569	8.1	0.05	-	112	-	7	10	4921	142	30
Ber	20.53	1.2	0.20	-	-	1.041	40	69	-	-	250	23	21	10	-	-	79
Star fruit	6.73	1.04	0.33	2.80	12	0.414	61	34.4	0.15	0	13	12	3	10	-	-	31
Mangosteen	17.91	0.41	0.58	1.8	31	0.467	35	2.9	-	-	48	9.21	12	13	-	-	73
Litchi	16.53	0.83	0.44	1.3	14	7.879	0	71.5	0.07	0.4	171	31	5	10	0	-	66
Avocado	8.53	2.0	14.6	6.7	81	3.581	146	10	2.07	21	485	52	12	29	385	1933	160
Apple	13.81	0.26	0.17	2.14	3	0.236	54	4.6	0.18	2.2	107	11	6	5	67	5900	52
Pear	13.81	0.38	0.12	3.10	7	0.27	23	4.2	0.12	4.5	119	11	9	7	59	2941	58
Plum	11.42	0.70	0.28	1.40	5	0.607	345	9.5	0.26	6.4	157	16	6	7	289	6259	46
Peach	9.54	0.91	0.25	1.5	4	1.039	326	6.6	0.73	2.6	190	11	6	9	320	1814	39

(Source: USDA National Nutrient data base): https://www.nutrition-and-you.com

changes in renal histology and histochemistry caused by gentamicin. Co-administration of kiwifruit with gentamicin prevented nephrotoxic changes to a modest degree. When administered subsequent to gentamicin intoxication, kiwifruit ameliorated significantly the histological and histochemical alterations caused by gentamicin. Our findings support the use of kiwifruit in cases of acute renal injury due to gentamicin.

Sleep inducing properties

Another beneficial effect of kiwifruit owing to its antioxidants and serotonin content has been investigated by some researchers. Lin *et al*., 2011 suggested kiwifruit consumption to improve sleep onset, duration, and efficiency in adults with self-reported sleep disturbances. Nødtvedt *et al*., 2017 reported kiwifruit possessing some sleep improving properties owing to its rich levels of nutrients, such as antioxidants, flavonoids, carotenoids, anthocyanins, folate, and melatonin, all of which could possibly facilitate sleep and effective against insomnia, the most common sleep disorder.

Wound healing process

Mohajeri *et al.* (2014) have revealed that natural compounds in the kiwifruit including protein-dissolving enzymes (Actinidin) improved different aspects of the wound healing process thereby suggesting its consumption effective in treatment of neuropathic diabetic foot ulcer. Owing to its antibacterial and pro-angiogenic effect, Mohajeri *et al.* (2015) even demonstrated effective use of kiwifruit pulp dressing on bedsores proving its wound healing ability. Earlier, Goudarzi *et al*., 2015 had provided evidences supporting the use of kiwi to accelerate wound healing in rats.

Allergies

Consuming kiwifruit causes allergies in some children and even in adult population. The allergy symptoms are wheezing, itchy feeling in the mouth and hypersensitivity. These allergy symptoms are owing to the presence of enzyme, actinidin in Kiwi fruit. It is also assumed that kiwifruit contains high oxalates which inhibit calcium absorption. Oxalate accumulation is leading to gallbladder and kidney problems. It also causes itching in throat upon consuming the fruit.

Allergic reactions to kiwifruit were first described in 1981(Fine, 1981). It was understood that kiwifruit is responsible for certain allergies but its clinical reasoning remained uninvestigated. Lucas *et al.*, 2004 made such an effort confirming kiwifruit as a significant food allergen causing severe reactions, particularly in young children. Maddumage *et al*., 2013 identified actinidin, kiwellin and thaumatin-like protein (TLP) as major allergenic proteins in kiwifruit. Later several researchers confirmed actinidin (Grozdanovic *et al.*, 2014; Uberti *et al.*, 2015), kiwellin (Uberti *et al.*, 2015) and thaumatin-like protein (TLP)(Uberti *et al.*, 2015). Le and Knulst, 2015 had identified 13 allergens in kiwifruit.

Handling the kiwifruit also leads to hypersensitivity reaction in some people (Fine, 1981). Gall *et al.*, 1994 revealed that Kiwi allergy is a new manifestation of birch pollen-associated food allergy. Moreno Álvarez *et al.*, 2015 observed more frequent allergy developing systemic reactions following kiwifruit ingestion in Spanish children. Garzorz, *et al.*, 2016 for the first time showed the phenomenon of allergy transfer from an allergic donor to a non-allergic recipient via hematopoietic cell transplantation. Haktanir Abul *et al*., 2017 had found out valuable conclusion that early introduction of allergic foods in the diet may lead to low prevalence of allergy and higher tolerance to the food.

Conclusion

After exploring the available information and research findings related to kiwifruit with reference to its nutrient content as well as health claims and the allergies associated with its consumption, it could be concluded that the nutrient content of kiwifruit is much higher compared to other commonly available fruits in India. Carbohydrates, proteins and fat content in kiwifruit are more or less at par with other common fruits. Fiber content in kiwifruit is very high except avocado and pear. This high fiber content is mainly attributing to improved bowel function. Folates, vitamin A and B complex, minerals and antioxident content of kiwifruit is moderately higher compared to some other fruits. Vitamin E content in kiwifruit is very high except avocado whereas Vitamin K content in kiwifruit is extremely high compared to all other fruits.

Research findings revealed that kiwifruit consumption has been effective in extending cardiovascular protective properties, antioxidant properties modulating immune responses, sleep inducing properties, wound healing process as well as improving bowel and renal functions. Along with the health benefits, some allergies are also associated with kiwifruit consumption. Researchers have proved that the enzyme, actinidin is mainly responsible for allergies due to kiwifruit consumption. Kiwellin and thaumatin-like protein (TLP) are other major allergenic proteins in kiwifruit. High oxalate content in kiwifruit lead to gallbladder and kidney problems as well as itching in throat. These allergic reactions are transferred from an allergic donor to a non-allergic recipient via hematopoietic cell transplantation.

In light of these important findings, consumers are suggested judicial use of kiwifruit in the diet.

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