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Super Foods for Liver Health: A Critical Review

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ABSTRACT: A special food category known as "Super foods" has emerged as a result of the advancement of food within nutrition. Superfoods are particular food items that are able to express numerous advantageous effects like mitigate multiple complications, this type of foods convey strong immunity, have chief compounds such as polysaccharides, polyphenols, essential fatty acids. Apart from that, it carries macro & microminerals in enough quantity. In modern community, super foods are substantial regard which is caused of enhanced health awareness of people. It is a functional food that protects against liver illness by helping the liver to detoxify. This critical review's goal is to analyse the effects of superfoods on liver detoxification from a scientific perspective.

Keywords: Superfoods, Brazil nuts, Hemp seeds, Garden cress seeds, Maca, Amla, Oats, Black rice, orange-coloured fruits & vegetables, tomato & pink grape fruits.

INTRODUCTION

For millions of years ago, with advanced study, foods &its constituent have positive influence on human health. People discrimination regarding foods has altered substantially. Aside from gratifying considerable requirement by adequate nutrition, consumer think that, foods have incredible power to maintain good health status by inhibiting ailments & increasing mental & physical health. This idea has remarkable point authorised by Hippocrates- 'Let food be thy medicine and medicine be thy food'. Foods that upgrade health status &decreases completely manifestation & also applicable for improving symptoms of disorders which is defined as 'Functional foods'. The expenditure of this term was proposed for first time before 30 years in Japan. Now it has been conceded all over the world. In modern community, super foods are the habitual term applied for functional foods. super foods are composed of antioxidant, polysaccharides, essential fatty acids. Moreover, super foods are considered as nutritious particularly as well as it is very much friendly to keep good wellbeing (Meyerding *et al*., 2018).

Super foods are considered as nutrient dense foods that promote good effects for establishing better health being, it also contains antioxidant which is functioned actively along with promote good bioavailability as it contains bioactive products. Moreover, superfoods establish good immunity. Noteworthy, Superfoods can be described as it constitutes all kind of natural sources of vitamin, minerals & other nutrients that helps for living healthy life with enormous health benefits (Jagdale *et al*., 2021). The phrase 'Super foods' was utilised for functional foods. it is contemplated to be an umbrella term for understanding the nature of foods. Furthermore, it's nutritional constituents provide advantageous effects for improving health condition (Lunn, 2006).

Additionally, superfoods are traditional food stuffs which escalates good functional properties through many processing applications than gene alteration (Hefferon, 2012). Super foods or functional foods promote healthy effects in body & stable macro or micro nutrients composition these are referred as functional foods which is processed negligibly & available in nature, also highlight that, distinct property

of being 'Traditionally utilised'. Super foods are utilised for establishing culinary & therapeutic advantages resulting these are obtaining attention not only for good beneficial effects but also provide advantageous characteristics of belonging to a community (Tacer-Caba, 2019).

Superfoods may be segregated as both food & medicinal plants based on "Plethora of synergistic components (Wolfe, 2009).

Numerous Researchers have examined that, antioxidant, bioactive compounds like anthocyanin, flavonoid, phenolic constituents, & their potentiality share strong impacts for mitigate liver complications.

ESSENTIAL BIOACTIVE COMPONENTS PRESENT IN SUPER FOODS

— Poly unsaturated fatty acids (Essential fatty acids) like ω-3 &ω-6 PUFA.
— Polyphenolic compounds.
— Polysaccharides.
— Vitamins.
— Essential amino acids.
— Sulphur constituents.
— Multiple enzymes (Holmes, 2015).

DIFFERENT SUPER FOODS AND THEIR HEALTH BENEFITS

Brazil nuts. Brazil nuts are most familiar consumed nuts. According to literature review, water, total lipid, protein carbohydrate is present in adequate quantity. It has appreciable amount of essential fatty acids along with contains low amount of saturated fatty acids. ω-3 fatty acids like α-linolenic acids are present in sufficient amount. It has also noted that, monounsaturated fat like oleic acid, saturated fat such as palmitic & stearic acids are also present here. However, there are also present microminerals like copper, chromium, iron. It is the abundant carrier of selenium (Moodley *et al*., 2007) compared to other nuts like cashew nuts, walnuts, pecans.

Yan *et al*. (2018) reported that inconsistent findings have been reported from clinical trials looking at the therapeutic value of omega-3 polyunsaturated fatty acids (-3 PUFAs) on nonalcoholic fatty liver disease (NAFLD). Researcher conducted a meta-analysis of randomised controlled trials (RCTs) looking at the impact of -3 PUFA supplementation on NAFLD, and we offer strong support for the hypothesis that -3 PUFA supplementation is effective in treating NAFLD.

Jagdale *et al.* (2021**)** reported that the Sulphur containing amino acids are present in required amount that boost selenium concentration & other minerals. In this context, tocopherol is also here in this nut (Ryan *et al*., 2006). β- sitosterol, stigmasterol, campesterol highlights 95% phytosterols which indicate highest antioxidant status. According to many authors, squalene is also present in Brazil nuts. Due to presence of these diverse nutrients, Brazil nuts are functional & nutritional constituents. As it contains efficient quantity of protein, amino acids, selenium there is generated affinity among constituents & fabricates organic complex along with high bioavailability (Yang, 2009).

It has pointed out that, suppression of HepG2 liver cancer cell manifestation after consumption of nut extracts in dose dependent manner. It has also noted that, phenolic compounds of Brazil nut have extensive hepatoprotective effects (Jagdale *et al*., 2021).

Hemp seeds as a super food. This type of seeds is crucial source of medicines, foods, fibres, religious or psychoactive medications. Hempseeds have considerable amount of oil, protein, carbohydrate, fibre, moisture, ω-3 & ω-6 PUFA (Leonard *et al*., 2020).

Crescente *et al*. (2018) noted that the oil of hempseeds is composed of unsaturated fatty acids linoleic acid & linolenic acids. Hempseeds have extensive source of protein, there are two major protein group presents like globular associated albumin & legumin associated globulin edestin (Aiello *et al*., 2016).

Wang & Xiong (2019) concluded that the Hemp protein carry out balanced amino acids like other super proteins: casein, soy protein according to FAO/WHO. Furthermore, glutamine, arginine is present (Lu *et al*., 2010). Apart from macronutrients, there is also present antinutritional constituents like tannin, phytic acids, trypsin inhibitors in very low concentration (Russo & Reggiani 2015).

According to Chen *et al*. (2012), it has great number of polyphenolic constituents. Highest amounts of calcium, zinc, copper, manganese, molybdenum, nickel, cobalt is present in low amounts (Siano *et al*., 2019). Studies have assessed that; Hempseed contains efficient amount of tocopherol. The foremost compound of polyphenol is phenylpropanoid which are named as Hydroxycinnamic acids amide (HAA), phenyl amides & their derivatives (Zhou *et al*., 2018).

Mamone *et al*. (2019) reported that Hempseeds contain tiny amount of allergen. Among allergens nonspecific lipid transfer protein (LTP) & thaumatin like protein are mostly absent after digestion. Moreover, the presence of allergen-analogues protein like serpins in HPI (Hemp protein isolate) & it's peptide section like warrants has digestion resistant capacity, promote advantageous effects.

According to Wang & Xiong (2019), hemp seeds have enormous capacity for liver detoxification& decrease gathering of fats in liver. In accordance with Kalra *et al*. (2018), male albino rats were utilised for determine the efficacy of hempseeds in liver detoxification. They asserted that, these are very much essential for liver detoxification as hemp seeds gave to albino male rats which highlights the significant efficacy at concentration of serum total protein, serum albumin, serum globulin, SGPT (Serum glutamic pyruvate transaminase), SGOT (serum glutamic-oxaloacetic transaminase), ALT (Alanine transaminase) in treatment group had no difference with control group. However, Researchers have also found that, cholesterol & triglyceride levels have supressed after consumption of hempseeds. Moreover, C-reactive protein have also decreased in male albino rats.

Garden cress seeds as a super food. It is very much knowing medicinal crops around world **(**Singh, 2017). Carbohydrate, lipids, crude fibre, protein are present in these seeds in adequate quantity. Fat is present

sufficiently. Essential fatty acids are present that efficiently act as memory boosters (Jain *et al*., 2016; Diwakar *et al*., 2010).

Various studies have related to seeds oil which constitutes essential fatty acids like linoleic acid, arachidonic acid, α linolenic acid. Oleic acid, linoleic acids, palmitic acids, α linolenic acids are present in oil. It is also noted that, Oil containing minor fatty acids are nervonic, arachidonic, stearic acids, eicosanoid acids (Jain *et al*., 2016).

According to Singh (2017), the most concentrated saturated fatty acid is palmitic acid & less concentrated palmitoleic acids are also there. Apart from these, it carries also micronutrients for growth sustainability like riboflavin, thiamine, niacin. These seeds contain calcium, phosphorus, magnesium, zinc in low quantity. Phytosterols like semi-lepidinoside A& B, β carotene, imidazole, Sinapic acid lepidine, sinapin are also present here (Jain *et al*., 2016).

Singh (2017) founded thatoil contains polyphenolic substances, tocopherol that has powerful antioxidant power. Noteworthy, fat & oil stabilization is important application of tocopherol that present in Garden cress seeds to stop oxidative damage. Leaves are functioned as mild diuretics & stimulants that prevents liver complication. It helps to maintain good liver status (Diwakar *et al*., 2010).

Behrouzian *et al*. (2014); Bansa *et al*. (2012) reported that aqueous extract of garden cress seeds administered to hypercholesteraemic rats for 8 weeks, after that resulting had shown that, weight gain, triglyceride, VLDL cholesterol, serum cholesterol, LDL cholesterol, cholesterol/HDL cholesterol, LDL/cholesterol/HDL cholesterol, urea, serum (AST, ALT) creatinine, total lipid, total cholesterol levels were all fallen down however escalated liver triglyceride level & serum globulin concentration.

Maca as a super food

Maca root is one of the ancient foods (Da Silva Leitão Peres *et al*., 2020). The major constituents of maca roots are starch, protein, dietary fibre (Wang & Zhu 2019). It is widely recognised that; Maca is considered as nutrient dense food but carries low energy. Mostly present among macronutrients are carbohydrate, starch. Highly present dietary fibre (Zhang *et al*., 2017).

Chen *et al*. (2017) noted that better protein store is also present in maca roots. Noteworthy, essential amino acids are also present as methionine, valine, threonine, leucine, isoleucine, phenylalanine, lysine in maca roots. Apart from that, non-essential amino acids are glutamate, aspartate, histidine, serine, alanine, proline, glycine, tyrosine, arginine, cysteine present in abundant quantity.

According to Wang & Zhu (2019) unsaturated fatty acids are also present. It is also interpreted that, microminerals like potassium, calcium, magnesium, sodium, zinc, manganese & copper are present in adequate quantity.

Zhang *et al*. (2017) reported that Maca root contains alkaloids, organic acids, β carboline, glucosinolates, common amide alkaloids, macamides, imidazole alkaloids. Maca decreases lactic acid in blood simultaneously, escalates glycogen store. Polysaccharides of maca prevent inflammation in liver along with shows active hepatoprotective functions. Forced swimming test performed on mice model ICR mice (female) & Kunming mice (male) for observing anti-fatigue activity. Therefore, outcome has resulted that, decreased blood lactic acid level along with glycogen parameter increased after consumption of 400mg/kg/day of maca root powder for 30 days (Li *et al*., 2017; Li *et al*., 2017; Tang *et al*., 2017).

Amla as a super food. It is the prominent therapeutic herb. It is also pharmaceutical & medicinal component (Krishnaveni & Mirunalini 2010).

Variya *et al*. (2016) noted that Amla carries bundle of chemical compounds like tannins, amino acid, flavonoid, glycoside, alkaloid, sesquiterpene, phenolic glycoside, Flavonol glycosides, phenolic acid, carbohydrate, non-sesquiterpenoids. In amla, Protein, carbohydrate, fat, fibre is here in supreme quantity. It has been extremely studied that, the total amino acid community consists of proline, aspartic acid, glutamic acid, lysine, alanine. Among macro nutrients, gallic acid, albumin, tannin gum, moisture, crude cellulose, minerals are also present there (Hasan *et al*., 2016).

Jagdale *et al*. (2021) reported that Amlahas alkaloid, tannin, phenolic constituents in large quantity and adequate amount of vitamin C.

Tewari *et al*. (2021) noted that Amla has a high concentration (252 mg per 100 g) of vitamin C.

Many phytoconstituents like chlorogenic acid, gallic acid, quercetin, ellagic acid are present in amla juice (Bansal *et al*., 2014). Furthermore, flavonoid community is composed of kaempferol 3-O-a-L- (600-methyl)-rhamnopyranoside, quercetin, in amla. As a mineral, there are present calcium, phosphorus, magnesium, iron, potassium, chromium, zinc, copper, nicotinic acid (Variya *et al*., 2016).

Variya *et al*. (2016) concluded that antioxidant properties of amla are extensively related with ascorbic acid like pedunculagin, emblicanin-B, emblicanin-A, punigluconin, gallic acid. Authors have assigned that, an ayurvedic exclusive formulations known as Triphala. It consists amla in highest quantity that is used as medication for hepatic S9 liver homogenate of phenobarbitone induced rat. It supresses actively mutagenicity. Moreover, Triphala has efficient hepatoprotective functions. It cures hepatic impairment along with it supress necrosis, liver infiltration.

Akhtar *et al*. (2011) concluded that amla had consumed for 21 days by mice & result had shown that, supress total cholesterol level, triglyceride parameter after intake of amla powder at quantity of 1, 2 or 3 gm each day.

Furthermore, increased HDL cholesterol & low LDL cholesterol level. Literature has also highlighted that, antioxidants of amla escalates modulatory effects of liver detoxifying enzymes (Jagdale *et al*., 2021).

Oats as a super food. It carries high quality proteins, carbohydrate, soluble dietary fibre like β glucan, fat, minerals, vitamins like B, C, E, K, phenolic acid, flavonoid, antioxidant like β carotene, polyphenol, chlorophyll, flavonoid & avenanthramides that also

have good activity to maintain healthy metabolism (Rasane *et al*., 2015; Maheshwari *et al*., 2019; Chen *et al*., 2021).

Some in vitro studies have also revealed that, protein is present in supreme quantity on the basis of amino acid composition (Klose & Arendt 2012; Daly *et al*., 2020) in protein biosynthesis, essential amino acids like lysine have important functions to keep healthy metabolism (Yang *et al*., 2020).

Researcher has pointed out that, lysine has prompt proportion of globulin rather than other grains which contain prolamin (Jaeger *et al*., 2021). In general, oats contain 3-11 % fat, maximum up to 18% fat. Noteworthy, Oats contains sufficient amount of oleic acid, linoleic acid & linolenic acids among unsaturated fats. Authors have confirmed that among saturated fatty acids, myristic acid, palmitic acid, stearic acid are also present there (Ahmet *et al*., 2019; Culetu *et al*., 2020).

Sterna *et al*. (2016); Yau *et al*. (2020); Bana´s & Harasym (2020) noted that Oats have oleic acid, linoleic acid, palmitic acid in adequate quantity. Palmitic acid supresses fat peroxidation. It has also better fat & fatty acid profile than other grains. Tewari *et al.* (2020) noted that Oats have β- Carotene as an anti-oxidant. However, in oats, calorie value of fat is in enhanced quantity rather than protein or carbohydrate (Kowalska *et al*., 2021). Oats holds raised amount of tocotrienol that highlight efficient antioxidant status. β glucan don't allow to gather cholesterol in liver along with promote better lipid metabolism (Kim *et al*., 2021).

Yau *et al*. (2020) reported that High fat diet (HFD) mice were administered with oats and/or *Lactobacillus rhamnosus* GG strain (LGG) for 17 weeks. After that, mass spectrometry based targeted lipidomic had given to assess short chain fatty acid (SCFA), Poly unsaturated fatty acid (PUFA) & also oxidized PUFA compounds. Outcome has declared that, acetone level was fall down by HFD in all tissues however it observed that, reversed in liver by supplementation of LGG, Oats or LGG + Oats. n-6/n-3 PUFA were present in adequate amount in HFD mice after consumption of oats. oats have strong antioxidant capacity in gut-liver-brain axis of HFD mice.

Black rice as a super food. Rahim *et al*. (2022) reported that black rice has a variety of nutrients, including potassium, fibre, protein, carbs, and vitamin B complex. It also has tocopherols and an antioxidant called anthocyanin. Most foods that are black or dark purple contain antioxidants. Black rice is a fantastic substitute for white and brown rice because of its high antioxidant content, high fibre content, and high nutrient density. By incorporating black rice into different dishes, food can have a higher nutritional content and become more useful.

Anthocyanin is one of the fore most component of black rice. It is described as health promoting foods. outer most part called bran hull has highest amount of anthocyanin. Generally, it's character is same as brown rice or unrefined rice. On the other point of view, black rice is enriched in increased amount of protein, vitamins, minerals in comparison with white rice. It has adequate amount of dietary fibre with mild or nutty taste. Due to presence of anthocyanin, deep black colour converts to deep purple in terms of cooking. It contains sufficient antioxidant therefore, has extreme free radical scavenging capacity. Apart from that Lysine, tryptophan is present in highest quantity. Specifically, vitamins like B_1, B_2, B_9, minerals like iron, Zinc, Calcium, Phosphorus, Selenium are present also there. vitamin C, E tocotrienol, carotenoid, enzymes like glutathione peroxidase, superoxide dismutase, glutathione reductase, metal binding protein like ferritin, albumin, lactoferrin, ceruloplasmin are also present as important constituents in oats. Previous study attempts to evaluate cyanidin glycoside is present in large quantity that counteract various disorders like it act as antihepatotoxicity agent. Moreover, antioxidant of black rice smoothly enhances cellular defence power. It promotes shield against liver injury, supress fatty liver complication, detoxify liver, ameliorate liver functions. Fatty acid metabolism is also upgraded after intake of black rice (Chakraborty & Vinay 2022).

Banerjee *et al*. (2019) noted that anthocyanin rich powder has given to mice then result showed that, black rice contained anthocyanin has multiple curing features. Furthermore, these all have super antioxidant capacity. It controls fatty acid metabolism. Supress hyper triglyceride level & cut down excessive cholesterol parameter. These all-good effects decrease complication of liver disease.

Orange coloured fruits & vegetables as a super food. It includes like citrus fruits, squash, sweet potatoes etc. These contain efficient number of phytochemicals such as carotenoid, antioxidant. Carotenoid is lipid soluble hydrocarbon. Carotenoids like α carotene, β carotene, lycopene, lutien, zeaxanthin, β-cryptoxanthin are derivatives of vitamin A. among these β carotene is present as precursor of vitamin A. this is very much crucial as important nutrients for boost up immunity, detoxify liver (Guest & Grant 2016). Furthermore, carotenoids are also described as carotenes that is originated from red coloured carrots, green leaves, yellow & red fruits & many roots. Carotenoids are referred as 'Phyto medicine'. Carotenoids may fall down liver complications like non-alcoholic fatty liver disorders (NAFLD).

Kavalappa *et al*. (2019) reported that, among carotenoid, β carotene is very much superficial for it's prooxidant activity in vitro, in vivo &in human trials (Ribeiro *et al.,* 2018). β carotene has active chain breaking antioxidant power for lipid peroxyl radicals (ROO) through scavenging O_2. In high concentration, β carotene break the concentration of products in 0.5-2.0μM in rat liver mitochondria. Therapy had conducted with β carotene on liver cancer cell line HepG2at 1-5 μM results had shown that, stop the growth signals like NF-kB (Nuclear factor kappa B), pAkt (Phosphorylated protein kinase), pERK (Protein kinase R-like endoplasmic reticulum kinase) & redox signals like Nrf-2 (Nuclear factor erythroid 2-related factor 2), SOD-2 (Superoxide dismutase-2) &HO-1(Heme oxygenase-1) however activated apoptotic

signals like PARP (Poly (ADP-ribose) polymerases), caspase.

Tomato & pink grape fruits as a super food. These carries lycopene which is one of the strong antioxidants like carotenoid according to various study. lycopene has extensive antioxidant activity. It shows intracellular gap junction communication, hormonal system adequacy & promote strong immunity. Few studies have assessed that, lycopene detoxify liver & improve antioxidant enzymatic function in hepatic tissues.

Karaca *et al*. (2019) noted that aflatoxin (AF) is very much closely involved for oxidative damage. In rat liver & the suppression capacity of lycopene against this toxicity was identified. Lycopene group was developed in 5mg/kg/day for 15 days, aflatoxin group (AFB1) was generated in 0.5 mg/kg/day for 7 days & also administered aflatoxin along with lycopene. Outcome highlighted that, enhances malonaldehyde level, decrease glutathione in aflatoxin group in comparison with control group. Simultaneously enhances aspartate transaminase, alanine transaminase, lactate dehydrogenase activity in aflatoxin group in comparison with control group. Supress malonaldehyde level, aspartate transaminase, alanine transaminase, lactate dehydrogenase & enhanced glutathione level, antioxidant activities in AFB1&lycopene group in comparison with AFB1 group. This study determined that, antioxidant activity of lycopene may be prevented from AFB1 induced hepatotoxicity.

Table 1: Antioxidant Properties of Different Super Foods.

Food Constituents	DPPH activity (mg TEAC/g)	TPC (mg GAE/g)	References
Brazil nuts	95.34	68.97	(John & Shahidi 2010)
Hempseeds	89.9	21.97	(Ning *et al*., 2022)
Garden cress seeds	26.55	374	(Adera *et al*., 2022)
Maca	89.3	46	(Dziecioł *et al*., 2023)
Amla	47	270.3	(Pereira *et al*., 2015)
Oats	38.58	598.2	(Ham *et al*., 2015)
Black rice	84.3	503.14	(Ghasemzadeh *et al*., 2018)
Orange coloured fruits	333.7	0.79	(Park *et al*., 2014)
Anthocyanin rich fruits	17.62	153.8	(Fraisse *et al*., 2020)

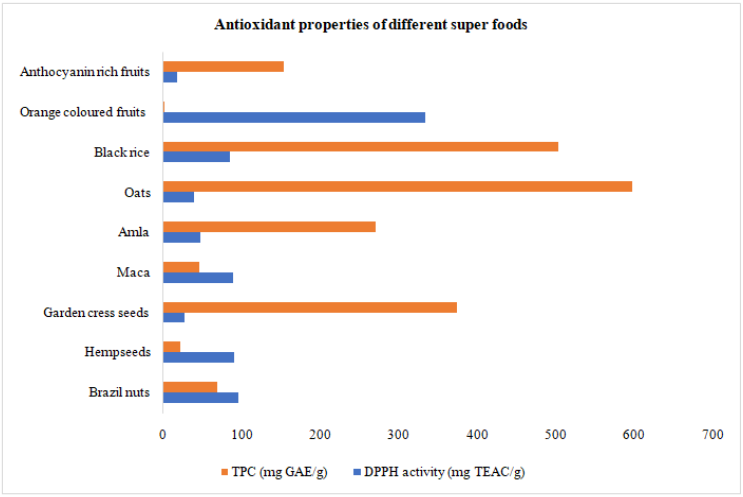

Fig. 1. Antioxidant properties of different super foods.

CONCLUSIONS

From this critical review it was concluded that the superfoods are nutrient-dense food items that deliver the greatest amount of health benefits, the best nutrition, and the fewest calories. It has extensive bioactive constituents & efficient nutrients which stop the manifestations of hepatic intoxication. Added super foods with normal diet are convenient avenue to maintain good metabolism. Superfoods would be much admired among people as they are very much conscious about health. Now a days, scientifically get extreme support about super foods.

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Conflict of Interest. None.

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