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BENINCASA HISPIDA IS AN ANTIOXIDANT OF POSSIBLE PHYSIOLOGICAL IMPORTANCE : A COMPARATIVE REVIEW

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Abstract

Benincasa hispida (Kundur), a member of Cucurbitaceae family, is one of the acclaimed crops that are grown primarily for its fruits and usually identified with its nutritional and medical possessions in particular in Asian countries. Kundur fruits has been appraised as a nutritious vegetable as it provides a good source for natural sugars, amino acids, organic acids, mineral elements and vitamins. The pharmacological studies revealed that the plant applied many pharmacological activities, inclusive of central nervous effects (anxiolytic, muscle relaxant, antidepressant, in Alzheimer's disease treatment to minimize opiates resignation signs), antioxidant, anti-inflammatory, analgesic, accouterments. diuretic, nephroprotective, antidiabetic, hypolipidemic and antimicrobial effects. As affluent source of functional important bioactives and therapeutics such as triterpenes, phenolics, sterols, and glycosides. This review pointed to the many pharmacological activities of *Benincasa hispida*.

***Keywords*:** *Benincasa hispida*, Cucurbitaceae, antioxidant, medicinal fruit, Pharmacological activities.

Introduction

B. hispida which usually named wax or ash or winter gourd (Curi *et al.,* 2017). *B. hispida* pertain to the cucurbitaceae family, *B. hispida* has presumably wide spread in china and India, civilized around Equator nations (Nimbal *et al.,* 2011). Kundur has well-liked in particular among Asian communities to feeding and therapeutic aims (Sew *et al.,* 2010; Zaini *et al.,* 2011). Kundur was favorite as baking vegetable boiled accompanied with or without meat. Also, it was accustomed to crude like chopped cucumbers (Stephens, 2012). However, Kundur primary using in medical field in various body systems like gastrointestinal disorders, diabetes mellitus, respiratory, urinary and cardiovascular diseases (Joshi, 2010). Kundur fruits commonly assimilated as a tonic, aphrodisiac, laxative, cardiotonicity, kidney stones, diuretic disorders, lunacy, schizophreniam (Blatter *et al.,* 2005) bile bladder diseases, digestion disorder and estrous cycle disorders (Jayasree *et al.,* 2011a; Jayasree *et al.,* 2011b). The main contents of kundur are flavonoids, fatty acids, saccharides, essential amino acids, carotenes, vitamins and minerals (Mandana *et al.,* 2012; Wu *et al.,* 1987). Chemical assays presented that galactose, fructose, glucose, xylose and sorbose are the principle sugar types in kundur (Rana and Suttee, 2012; Chidan Kumar *et al.,* 2012). The antioxidation property of kundur seeds extract was researched by using Solid–Liquid Extraction (SLE).

Effects on central nervous system

The anxiolytic impacts of kundur alcoholic extract have been estimated using assessed Elevation Plus Maze (EPM) test, light/dark transformation (LDT) test and casual moving action. *B. hispida* extract drinking by mice spent period increment with open arm ratio at the (EPM) test, whereas increment at spent period in the illustrate (LDT). *B. hispida* extract couldn't alter the voluntary moving activity (Nimbal *et al.,* 2011). *B. hispida* alcoholic extract displayed consequential anti-compulsive wind up in marble burying behavior confirm at mice, whereas gain that will be hackneyed for putting of serotonin hormone activity (Girdhar *et al.,* 2010; Abass and Sakran, 2019a). *B. hispida* methanolic extract showed decreasing in voluntary moving action with no muscular relaxation action. It also meaningful coma which produced from barbiturate, and revealed meaningful antihistaminic action (Babu *et al.,* 2003). The anticonvulsant features of *B. hispida* methanolic extract was researched on maximal electroshock seizure test (MEST). Methanolic extraction of *B. hispida* preserved against maximum electroshock induce convulsion with diminished curing time meaning from cramp (Nimbal *et al.,* 2011). The anti-tranquilizer action of the kundur alcoholic extract was approved in comparison with humanistic anti-tranquilizer therapy. Alcoholic extraction of kundur revealed meaningful anti-tranquilizer-like activity apparently by suppressing Monoamine oxidase A, and by reciprocation with α1-adrenergic, serotoninergic, dopaminergic and GABAergic systems (Dhingra and Joshi, 2012; Abass and Sakran, 2019b).

B. hispida aqueous extract improved symbolic action against of morphine disengagement symptoms. The conclusions revealed that *B. hispida* was effective in blocking morphine inclination and elimination of opioid resignation in animals (Ghosh and Baghel, 2011). It had likewise act as antioxidants development in various cerebral parts, which elevated the times of appropriate preferences out of 10 constantly effort and depreciated inactivity time dose dependent (Roy *et al.,* 2008).

Alzheimer disorder treatment

Alzheimer's disorder (AD) is a progressive dementia in old age, a neural degenerative disorder that identified by the amnesia, thinking and psychic reflexes depression (Mandal *et al.,* 2014). Free radical origination increasing (oxidative factors) especially in elderly primarily implicated in neuronal damage that appointed to this disease (Pratico and Delanty,

2000). Roy *et al.,* (2007); Roy *et al.,* (2008) which showed that 450 mg / kg bw of *B. hispida* lead to protecting impact on colchicine inducing myoneuropathy tested rats conceivably through the reduce amyloid-β and existence of γ-tocopherol protecting rat neurons to reduce oxidation as a result.

Effects on gastrointestinal system

By using of DPPH method to studding antioxidation effect and free radicals scavenging of the methanol extract of kundur seeds and by using, Water immersing restraint stress (WRS) and Indometacin [INDO]-inducing gastric mucosal damage in rats. *B. hispida* seeds extract improved correlation between dependent DPPH concentration and pyloric association action (Purohit *et al.,* 2019). It was also withdrawing stomach ulcer by reducing volume of stomach and free and total gastric acidity. *B. hispida* aqueous extract dose (300 mg/kg) revealed meaningful devaluation ($p<0.05$) in gastric acidity which in compared to Dimethyl as main therapy. *B. hispida* alcoholic extract excerpt induced more than 50% inhibition in pyloric ulceration during water immersion restraint stress (WRS) and Indometacin -induced stomach ulcer (Gill *et al.,* 2011).

Antiulcer action of Benzene and methanol excerpts of *B. hispida* were further measured in rats. Benzene and *B. hispida* alcoholic extract were given as oral dose (300 mg/kg), and proton pump inhibitors (PPI) (20 mg/kg) as dose. Both of them created evidential decreasing in ulcer index in whole the patterns (alcohol-induced stomach mucosal impair, pyloric linked ulcer pattern, restraint and cold stress-induced stomach ulceration pattern), in comparable with results of proton pump inhibitors treatment. Forever, a meaningful decreasing in vascular penetrability was showed also. Nevertheless, in cold and constraint stress-induced stomach ulcer pattern (Rachchh and Jain, 2009; Hasan *et al.,* 2019; Ahmed *et al.,* 2019). *B. hispida* alcoholic extract excerpts of the advertised a meaningful anthelmintic action in dose dependence method. The pattern was achieved in vitro testing earthworm receivable to its biological coincidence with the internal parasites of humans (Muley *et al.,* 2012). Different doses of the alcoholic excerpt of *B. hispida* were presided over to local albino mice to inspect the anorexic effect. Alcoholic excerpt of *B. hispida* meaningfully decreased the aggregation of feeding over period seven hours in dose depending pattern. At first four hours stomach clearance wasn't meaningfully affected by *B. hispida* in comparing to control. It was hypothesized that the anorexic action of Kundur was moderated through the brain without impacting the stomach clearances (Kumar and Vimalavathini, 2004).

Anti-ulcer effect

Rachchh and Jain (2009) tested of *B. hispida* extract anti-ulcer action in rats. An experiment by Grover *et al.* (2001) in comparing with various extrication assays, revealed that the supernatant and methanolic extract appreciably decreasing ulcerative size mean in comparing with control. The end results showed that floating part of *B. hispida* extract is indicating that the active antiulcerogenic of *B. hispida* fruit components is hydrosoluble. As attested by Grover *et al.* (2001), benzene and alcoholic of *B. hispida* extracts formed a meaningful decreasing ($P<0.05$) in ulcer index when tested by using different patterns (alcohol-induced stomach damage, pylorus ligation (PL) stomach ulceration, and cold refrainment stress induced stomach ulceration. Nevertheless, alcoholic extract of kundur revealed more protective percentage (67%) in comparison to (49%) benzene extract.

The stomach protection from ulcers which produced by pylorus ligated which revealed to formed by inhibition levels of gastric juice and protect of mucosal lining barrier, depended on decreasing in levels of protein with correlated increment in levels of carbohydrate which causes a marked increasing at mucin action (Grover *et al.,* 2001). Those results are farther improved by Shetty *et al.* (2008) who tested curing impact of *B. hispida* extract on indometacin-induced ulceration. Previous research improved high probability at ulcer index reduction at rats in case of administrated with *B. hispida* extract which linked to found of tetraterpenes in the *B. hispida* (Palamthodi *et al.,* 2019; Kasim *et al*., 2019).

Anti-diarrheal effects

Depending to Bhyrapur Mathad *et al.* (2005), *Benincasa hispida* extract would represented an active anti-diarrheal therapy in case tested in compared with ricinus oil, which it revealed a meaningful decreasing in circumstance and asperity in diarrhea idols. Ricinus oil or it activated part ricinoleic acid form penetrability changing at fluid of mucosa and electrolytes transporting which resulting high responding to diarrhea and secretion (Yacob *et al.,* 2016). The results revealed a meaningful decreasing in defecation recurrence and the humidity of the feces stools in comparing with treated and non-treated rats (Abdullah *et al.,* 2012; Gulbahar *et al.,* 2019).

B. hispida extract inhibited the actuation of charcoal meal, whereby increment of water absorption and electrolytes. The pathway that implicated at anti - diarrhea effort of *B. hispida* might be attributed to repression of gastrointestinal motility (Kalure, 2011). Nevertheless, additional study is important to active substances identification and specified mechanization. *B. hispida* alcoholic extract was increased for antidiarrheal activity against various study of diarrhea idols cases at rats. When animals tested with *B. hispida* alcoholic extract revealed meaningful depressing action against ricinus oil produced diarrhea and depressed $PGER_2$ formed enter accretion in rats. *B. hispida* alcoholic extract also revealed meaningful decreasing at gastrointestinal mobility subsequent to charcoal meal in rats (Vrushabendraswamy *et al.,* 2005).

Antioxidation effects

Antioxidative action with total phenolic contents (TPC) extract antioxidative action and (TPC) were tested by use conventional Soxhlet extraction (CSE), DPPH and ABTS withdrawing action experiments. The antioxidative action and (TPC) of alcoholic extract transmitted highest (TPC) (12.5±1.9 mg) GAE/gm. and anti-free radicals action precede by n-hexane and ethyl acetate extract (Mandana et al, 2012). Antioxidant factors scavenging action of aqueous and methanolic extraction of *B. hispida* dried overripe flays had estimated by DPPH. The aqueous and methanolic extraction of *B. hispida* presented relevant activity at dependent dose in comparing with the vitamin C. The high eliminative action of *B. hispida* aqueous extract at 87% as (100 µg /ml) concentration and that of alcoholic extract at 88% (100µg /ml) concentration (Rana and Suttee 2012).

B. hispida administration lead to meaningful increment in Superoxide dismutase (SOD) in erythrocytes with plasma level of ascorbic acid in rats. It was patent reduction in animal's index of ulcer supplied by *B. hispida* extract. The study of Shetty *et al.* (2008) hypothesized that *B. hispida* extract presumably restrain stomach mucosal lesion by oxidative factors scavenging. The antioxidation limit of *B. hispida* extracts peel, mush and seed were tested by various assays like removing action, Fe^{3+} decreasing activity and carotene discoloring assays. For (TPC). The *B. hispida* seed extract performed antioxidant peak limit for removing action, Fe^{3+} decreasing action and carotene discoloring assays and additionally exhibited highest (TPC) as in comparing with *B. hispida* extracts peel and mush (Arora and Kaushik 2016). It was progressive relationship were acquired for (peel, seed and mush) parts of Kundur extracts in (TPC) with Fe^{3+} relationship activity and with 2% free radicals action.

Moreover, negative correlation was initiated between (TPC) with removing activity for different parts of wax gourd extracts deliberated (Abdullah *et al.,* 2012). (250 and 500 mg/kg) dose of *B. hispida* in mice produced dose dependent reduce in plasma levels of sugar, cholesterol and insulin. *B. hispida* extract was increasing at Malondialdehyde (MDA) level much as tripeptide glutathione (GSH) and Superoxide dismutase reduction (Rachchh *et al.,* 2011).

Anti-inflammation and analgesic activity:

Gill *et al.* (2010) was inspected the anti-inflammation impact of *B. hispida* fruit. Chandrababu and Umamaheshwari (2002) tested the anti inflammatory possessions of *B. hispida* fruit peel with juices, independently. Gill *et al.,* (2010) proposed which oxidative factors scavenging action of *B. hispida* seed could amenable for decreasing of carrageenan-produced inflammation foot oedema in rats (Cuzzocrea *et al.,* 2001). *B. hispida* anti inflammatory impacts of could correlated to existence of terpenoids biological action (Shetty *et al.,* 2008). Conforming to Miro (1995) terpenoids strayed from many kundur families obsessed anti-inflammation action. The preparatory surveys of *B. hispida* extract resulted that it performed anti-inflammation possessions.

The anti-vascular inflammatory action process of *B. hispida* (ABH) antigen expression in human umbilical vein endothelial cells (HUVECs) was tested. *B. hispida* (ABH) antigen expression suppressed monosaccharide produced cells adhesive molecules (CAMs) outer membrane at polypeptides aspect, leading to decreased adhesion of monocytes antigens (Une and Doshi, 2016). *B. hispida* (ABH) antigen expression also prevented mRNA expression levels to chemo attractant protein 1 (MCP-1) and (IL-8) in monocytes. Monosaccharide persuaded Reactive Oxygen Species (ROS) preformation has constrained by (ABH) antigen expression of *B. hispida*. Early treatment of (HUVECs) with ABH antigen expression of *B. hispida* blocks NF-κB invigoration via block of activity to phosphorylation and degeneration of *B. hispida* suppressive action protein, IκB-α.(ABH) antigen expression of *B. hispida*. decreased NF-kB promoter action (Moon *et al.,* 2009).

Treatment of asthma

B. hispida fruit methanolic extract (MEBH) presented mast cell stability actin and performed to have active repressive impacting on the histamine releasing produced by antigen antibody complex (Minh *et al.,* 2019). (MEBH) showed perfect fortification against the histamine which form asthma attack even at little dose. Nevertheless, at a high dose (300 mg/kg) level. *B. hispida* fruit alcoholic extract didn't relevant defend against acetylcholine asthma attack (Yoshizumi *et al*., 1998). The study Kumar and Ramu (2002) propose that the protection impact against asthma attack formed by histamine haze can be intermediate by composing antihistaminic action (H1 receptor antigenicity).

Effect on urinary organs:

The Lasix action at (25-200 mg/kg) *B. hispida* fruit extract was estimated in male guinea-pig adults. It resulted a symbolic increase at volume of urine. There might be a relevant increment at Na^{2+} with Cl^{1-} excretion with reduction at K^{1+} excretion (Jayasree *et al.,* 2011b). *B. hispida* extract has profound increment in volume of urine, Na^{2+} and Cl^{1-} levels, and crucial reduction in K^{1+} excretion in tested rats when performed of (100 mg/kg) (Jayasree *et al.,* 2011a).

Using of (240 and 550 mg/kg) *B. hispida* extract by oral supplementation deep decreasing of urinary excretion and protein, Ca^{2+} and oxalate retention in kidney. Furthermore, increased of Na^{2+}, creatinine, Ca^{2+} and P_4 serum levels were relevant decreased by the extracts (Patel *et al.,* 2011). The nephroprotective action of *B. hispida* aqueous and alcoholic extract was tested in acetaminophen produced increment in kidney toxicity in rats. Using of (220 and 450 mg/kg) aqueous and alcoholic extract of *B. hispida* treatment of interrupted the Acetaminophen - stimulated kidney toxicity and free radicals deterioration in kidneys, whereas confirmation by relevant decreased in mass of kidney, urea of blood, urinary creatinine, urinary sugar and K^{1+} concentration and as well increment of body weight, volume of urine, creatinine in urine and total blood protein level (Rajalakshmi, 2018).

Aqueous and *B. hispida* methanolic extract meaningful increment GSH levels in tissues and diminish lipid peroxide content. Moreover, it had proved by microscopic examination which necrotic changes resulted of acetaminophen which revived by aqueous and kundur methanolic extract treatment (Varghese *et al.,* 2013). In rats, it was formed protective action to urinary system against hydrargyrum Hg^{2+} poisoning (Mingyu *et al.,* 1995).

Hypoglycemia and hypolipidemia effects

B. hispida stem chloroform extract has relevant hypoglycemia action in male rats. The highest decreasing in glucose levels in the plasma with *B. hispida* chloroform extract was reported at (200 mg/kg) (Jayasree *et al.,* 2011c). *B. hispida* salad had been supplied by mixing 95 gm. of kundur, 1 gm. leaves of curry, and 5 gm. of dry powder of milk, pepper and low NaCl are provoked to give a good taste. This mixture has newly performed day by day and accustomed to diabetic persons in afternoon for 85 days to become aware medicinal impact of *B. hispida* adding (Perez-Ramırez *et al.,* 2015). *B. hispida* Supplement had relevant decreasing in blood glucose and fat mass (both with out and after feeding), during duration of 85 days (Amirthaveni and Priya, 2011). (250 and 500 mg/kg) of *B. hispida* in mice produced decline levels in blood sugar, cholesterol and insulin hormone in plasma (Rachchh and Jain2009).

Antibacterial effects

The antimicrobial action of kundur seed oil might be examined against preferred pathogens (gram +ve , *Staphylococci, Streptococci, Pneumococci* and gram -ve, *E. coli*, *Salmonella*, *Shigella*, and *Pseudomonas*) (Tahir *et al.,* 2013). Nevertheless, the antibacterial action of *B. hispida* methanolic extract was tested against *Staphylococcus aureus*, *Staphylococcus epidermidis.* and *B. subtilis* as gram +ve bacteria and *E. coli*, *P. aeruginosa* and *K. pneumoniae*, and antimycotics action had detected counter to *C. albicans* and *A. niger*. The *B. hispida* methanolic extract revealed stopping of antimicrobial action, but it caused profound inhibition zone against (30 mg/ml) *Candida albicans*, while, their wasn't inhibition counter to *Aspergillus Niger* (Natarajan *et al*., 2003).

Anti-obesity Effect

Kumar and Vimalavathini (2004) showed conceivable anorectic of *B. hispida* activity, most presumably mediated across brain without influence the gastric unpack. Anorectics are appetite reduction to feeding (Mishra *et al*., 2016). Some experiments Duggan and Booth (1986) improved that decreasing of mice food intake hadn't relationship with stomach unpack, whereas stomach unpack had been an informal related by overindulge. *B. hispida* could be accustomed to an effective anti-obesity substances because of decreasing in feeding (Zhang, 1996).

Contradiction and side effects

In many toxicological researches in rats (Qadrie *et al.,* 2009, Jayasree *et al.,* 2011c), Kushmanda (*B. hispida*) extract, high safety and no mortality was consecrated at a high dose as 10 gm/kg. *B. hispida* chloroform extract had been examined for high morbidity in rats. The parameters which were consecrated were high activity, anodyne, mislay reflex, decreasing of respiratory rate and paroxysm. No toxic impacts and mortality were recorded (Jayasree *et al.,* 2011a).

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