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## Role of katuka (*Picrorhiza kurroa* Royle ex Benth.) in obesity W.S.R to Ayurvedic and modern aspect: A review

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### Abstract

The global epidemic Obesity is affecting 300 million people world-wide and 22 million people in India. According to *Ayurveda* Kapha-vata vikruti, hypo functioning of Jathragni, Medodh wagni and *Ama* production lead to excess enhancement of vitiated medovridhhi. The pathophysiological changes in medovridhhi have shown similarity with those of obesity. *Katuka* (*Picrorhiza kurroa* Royle ex Benth.) on account of its attributes like *tikta rasa*, *sheeta Virya*, *katu Vipaka* and *laghu, ruksha guna* perform the function of *Lekhan* (Scraping), *Deepan* (restoration of *Agni*), *Pachan* (Digestion), *Bhedan* (purgative), vata kapha nashan (alleviates *vata* and *kapha* in the body) and *Hridya* (cardioprotective), *Pramehaghna* (Anti-diabetic) and *Yakrut Gana* (Hepato-protective) *karma* (action). *Katuka* possesses choleric (Pittavirechak) and cholegogue (*Virechak*- purgative) action. Moreover *Katuka* is useful in Obesity associated with comorbidities like Cardiac disorders, Hyperlipidemia, Diabetes, Liver disease and Cancer. This paper presents its role in obesity on the basis of *ayurvedic* and modern parameters.

**Keywords:** Obesity, *Katuka*, *Picrorhiza*, hyperlipidemia

### 1. Introduction

Obesity is called corpulence or fatness, excessive accumulation of body fat which is usually caused by the consumption of more calories than the body can use. The excess calories are then stored as fat, or adipose tissue. Obesity is a global epidemic [1]. Obesity has reached epidemic proportions in the 21<sup>st</sup> century with morbid obesity affecting 5% of the country's populations. In Northern India, obesity is most prevalent in Urban population (Male=5.5%, Female=12.6%) followed by the Urban slums (Male=1.9%, Female=7.2%) [2]. Statins are the drug which is used in obesity. Anti-obesity drugs have many side effects like gastrointestinal symptoms, headache, myalgia and dizziness [3]. The medicinal plants are cost effective, easily available, and minimum side effect. In *Ayurveda* the chapter 4 of *Charak Samhita sutrasthan* deals with 50 different groups of 10 herbs with common action. The third of these groups is *Lekhaniya Mahakashaya* i.e. plants acting as scraping agents. *Katuka* (*Picrorhiza kurroa* Royle ex Benth.) included in *Lekhaniya Mahakashaya* [4]. It is found in the Himalayan region Kashmir to Sikkim at an elevation of 2700-4500 meter and in Nepal, found abundantly between 3500 and 4800m [5]. *Kutki* is a perennial herb with an elongated rhizome [6]. *Katuka* having *Bhedan* (Purgative), *Hridya* (Cardioprotective), *Prameghna* (Anti-diabetic), *Lekhan* (Scraping), *Yakrut Gana* (Hepato-protective), *Deepan* (restoration of *Agni*) Properties [7]. It also shows the Cardioprotective, Hepatoprotective, Hypolipidemic, Anti-obesity, Purgative, Anti-oxidant, Anti-inflammatory, Anti-diabetic action. This review shows the Understanding the pharmacokinetics of *katuka* (*Picrorhiza kurroa* Royle ex Benth) in obesity with special reference to *ayurvedic* and modern aspect.

### 2. Ayurvedic aspect

Thorough review of *Katuka* was taken from various *nighantu*. The study of phytochemistry and anti-obesity mechanism of *katuka* from various related work done published in research papers and articles was also studied.

#### 2.1 Obesity (*Medorog*)

According to *ayurveda*, *Atisthaulya* (Obesity) is described as unnecessary deposition of *meda* (fat/adipose tissue) due to hypo-functioning of *Medodhatu* leading to flabbiness of hips, abdomen, and breast. *Atisthaulya* is one of the *Santarpanotha vikaras* (disease due to consumption of excessive calories) in *Ayurveda* [8].

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## 2.2 Information about *Katuka*

### Synonyms <sup>[9]</sup>

<i>Matsyasakala</i>	-	The part used rhizome, has fishy scales.
<i>Chakrangi</i>	-	Is circular on section.
<i>Krsnbheda</i>	-	Blackish on breaking.
<i>Katvi</i>	-	Unpalatable.
<i>Tikta</i>	-	Bitter in taste.
<i>Matsyapitta, sakuladani</i>	-	Like fish bile.
<i>Rohini, katurehini, asokarohini</i>	-	Regenerative.
<i>Amaghni</i>	-	It removes ama (Immature ahara rasa/waste substances associated with ama).
<i>Arista</i>	-	Safeguards against disease.

### 2.3 Raspanchaka <sup>[5]</sup>

<i>Rasa</i>	:	<i>Tikta</i>
<i>Virya</i>	:	<i>Shita</i>
<i>Vipaka</i>	:	<i>Katu</i>
<i>Guna</i>	:	<i>Laghu, Ruksha</i>

### 2.4 Pharmacodynamics

*Bhedan* (Purgative), *Lekhan* (Scraping), *Deepan* (restoration of *Agni*), *Pachan* (removes toxins), *Hridya* (Cardioprotective), *Prameghna* (Anti-diabetic), *Lekhan* (Scraping), *Deepan* (restoration of *Agni*), *Pachan* (removes toxins), *Yakrut Gana* (useful in hepatic disorders) *karma* (Actions) <sup>[5]</sup>.

## 3. Modern aspect

### 3.1 Obesity

Obesity may be defined as an abnormal growth of the adipose tissue due to an enlargement of fat cell size or increase in fat cell number or combination of both <sup>[10]</sup>.

**3.1.1 Hyperlipidemia:** Elevated lipid (fat) levels in the blood. Hyperlipidemia can be inherited and increases the risk of disease of the blood vessels leading to stroke and heart disease.

### 3.2 Taxonomical classification <sup>[11]</sup>

Kingdom	-	Plantae
Division	-	Dicotyledonae
Class	-	Asteride
Order	-	Scrophulariales
Family	-	Scrophulariaceae
Genus	-	<i>Picrorrhiza</i>
Species	-	<i>Picrorrhiza kurroa</i>

### 3.3 Phytoconstituents

Picrorrhizin, kutkin-glycosides, D- mannitol, Bainilik, Kuttikol, Kutakaki-sterol, Picrorrhizin, Kutkoside, Picoside, Apocynin <sup>[12]</sup>.

## 4. Pharmacological action

### 4.1 Anti-obesity

Diabetes is frequently associated with Obesity. It was reported that the antihyperglycemic activity of *Picrorrhiza kurroa* in streptozotocin induced diabetic rats was proved. To evaluate the effect of *Picrorrhiza kurroa* on high fat diet (HFD) induced obesity in rats, a model which mimic several features of human obesity was taken. Rats were provided with HFD libitum for 15 days, rats with significant weight gain compared to normal pellet diet (NPD) group, were selected for further study. *Katuka* (100 and 200 mg/kg) treatment was started on 16<sup>th</sup> days onwards till 30<sup>th</sup> day. Control group rats

were provided with NPD for 30 days. Body weight was recorded on day 1 followed by weekly basis. Fasting blood samples were collected on 15<sup>th</sup> and 30<sup>th</sup> day and total cholesterol, LDL-C, HDL-C and triglycerides level were estimated. Rats fed with HFD gain significant weight compared to NPD fed rats after 15 days ( $p < 0.05$ ). The increase in body weight was continued upto 30<sup>th</sup> day in rats maintained on HFD. Unlike *Picrorrhiza kurroa* treatment significantly inhibited weight gain compared to vehicle treated HFD rats. *Picrorrhiza kurroa* significantly reduced ( $p < 0.05$ ) total cholesterol, LDL-C, triglycerides while HDL-C was significant increase compared to vehicle treated HFD rats <sup>[13]</sup>.

### 4.2 Antioxidant activity

Antioxidant agents work as radical scavengers that prevent the human body from various diseases reported that activities of liver enzymes are reduced among the liver cirrhosis patients subsequent the treatment with the *Picrorrhiza Kurroa* plant extract <sup>[14]</sup>. The antioxidant effectiveness of plant extracts were reported employing radical scavenging assays, ferric reducing antioxidant property and thiobarbituric acid assay for analyzing inhibition of lipid peroxidation <sup>[15,16]</sup>. The rhizome ethanol extract of *Picrorrhiza kurroa* at the dose of 20 mg/ kg body weight, healed rapidly the stomach wall of indomethacin induced gastric ulcerated rats by an *in vivo* free radical scavenging action used diverse antioxidant testing methods to corroborate the antioxidant efficacy of the leaf fractions of *Picrorrhiza kurroa*. The extract showed DPPH radical scavenging and metal chelating activities with IC50 of 75.16±3.2 and 55.5±4.8 µg/mL and exhibited potent reducing power with antioxidant activities. Antioxidant and radical scavenging activity of *Picrorrhiza kurroa* (*Katuka*) extract indicate its active role toward different oxidative stress related diseases, as a food supplement and source of natural antioxidants <sup>[17, 18]</sup>.

### 4.3 Hypolipidemic activity

A hypolipidemic effect of the water extract of *Picrorrhiza kurroa* was observed in a high fat diet feeding hyperlipidemia mouse at doses of 50, 100 and 200 mg/kg, orally, once a day for 12 weeks. Liver weight, serum aspartate transferase (AST), alanine transferase (ALT), low density lipoprotein (LDL), triglyceride (TG) and total cholesterol levels were significantly reduced by the treatment. On the contrary, serum HDL level seems not affected by *Picrorrhiza Kurroa* (*Katuka*) water extract <sup>[19]</sup>.

### 4.4 Anti-inflammatory

Anti-inflammatory activities Inflammation is a restricted defensive response of tissue to irritation or infection, characterized by redness, swelling, pain and at times loss of function. Apocynin, an active phyto-constituent of root extracts has been evidenced to possess anti-inflammatory properties. The inhibition of oedema at the rate of 29.8% reveals that (*Picrorrhiza kurroa*) is an active anti inflammatory drug <sup>[20]</sup>. The application of *Katuka* (*Picrorrhiza kurroa*) rhizome extract significantly inhibited joint inflammation. It also exhibits potent anti-inflammatory activity against chemically induced inflammation and may be regard as a high-quality naturally occurring analgesic <sup>[21]</sup>.

### 4.5 Antidiabetic activity

DM (Diabetes mellitus) is a common group of metabolic disorders that show the phenotype of hyperglycemia. It is

distinguished by high blood glucose level caused due to insulin deficiency and often associated with insulin resistance *Picrorrhiza kurroa* root extract treatment influenced significant ( $p < 0.001$ ) reduction in fasting blood glucose level in streptozotocin-nicotinamide induced type-2 diabetic rats, illustrating antidiabetic activity [22].

#### 4.6 Hepatoprotective activity

*Kutkin* (Picrosides and kutkosides) has hepatoprotective activity. A hepatocyte is a cell of the main parenchymal tissue of the liver and make up 70-85% of the liver's mass. Hepatocytes death leading to hepatic injury when there is an elevation in the level of normal serum transaminase enzymes *Picrorrhiza kurroa* has noteworthy hepatoprotective action against carbon tetrachloride intoxicated rats and Amanita poisoning [23,24,25]. The herbal extract supplies advanced nutraceutical activity for superior hepato-protection by improving intestinal absorption [26].

#### 4.7 Cardioprotective effect

Normal rat pre-treated with *Picrorrhiza kurroa* (200 mg/kg) alone did not show noteworthy change; however, application of isoproterenol leads to hemodynamic and left ventricular dysfunction, lipid peroxidation and oxidative stress. Such type of cardiac dysfunction was considerably prohibited by the plant's root extract. Pre-treatment with root extract significantly checked the isoproterenol-induced oxidative stress by renovating various enzymes like myocardial superoxide dismutase, catalase and glutathione in lipid peroxidation, which prevent the outflow of myocyte creatine kinase MB and lactate dehydrogenase enzymes. The outcome suggests that the root extract possesses effective cardioprotective properties that may be attributed to its future use [27].

#### 4.8 Anticancer activity

Malfunctioning in the mechanism of apoptosis may lead to infinite growth and cell division. The dichloromethane fraction of *Katuka* (*Picrorrhiza kurroa*) showed efficient anticancer activity and may be recommended to explore for cancer therapy [28].

#### 4.9 Analgesic activity

Analgesic activity of the plant was assessed by the treatment of alcoholic root extract. The analgesic activity was assessed by employing the Hot plate and Acetic acid induced-writhing technique in albino mice of either sex. The 500 mg/kg extract dose of *Picrorrhiza Kurroa* had shown comparable effect in comparison to the standard drug pentazocin when kept for ½ hr [29].

#### 4.10 Antimicrobial activity

Antifungal activity of root extract of *Picrorrhiza kurroa* was examined against *Candida tropicalis*, *C. albicans*, *Penicillium marneffi* and *Trichophyton rubrum*. Alcoholic solvent of the root extract at 10% were effective in the inhibition of these clinical fungal isolates [30]. Moreover, acetone and methanol extracts of dried stolons of *Picrorrhiza kurroa* exhibited broad range of antimicrobial activity against majority of the pathogenic microbes such as *Gloeocercospora sorghi*, *Erwinia chrysanthemi*, *Rhizoctonia solani*, *Fusarium oxysporum* and *Sporisorium scitamineum* [31]. Also, 0.1% stock solution of chloroform, methanol and water extract was found to illustrate antimicrobial activity [32].

#### 4.11 Immunomodulatory activity

An immunomodulatory agent is a type of drug that may act as an immunostimulator or an immunosuppressant based on its effect on the immune system reported the immunostimulatory activity of biopolymeric fraction RLJ-NE-205 from *Picrorrhiza Kurroa* [33]. Biopolymeric fraction induced both the humoral and cellular parts of the immune system. Ethanolic extract of *Picrorrhiza kurroa* leaves was able to stimulate humoral as well as cell mediated components of the immune system and also phagocytosis in investigational animals [34, 35]. Two powerful anticomplementary polymeric fractions were isolated that plays an important role in the antigen non-specific defense. The analysis supports the assumption that the rapeutical preparations made from *Picrorrhiza kurroa* roots may influence on immune mechanisms further, reported that the alcoholic extract of the root is more potent than aqueous extract in producing delayed type hypersensitivity response [36, 37].

#### 4.12 Digestive activity

*Picrorrhiza* is used in India for the people with constipation due to insufficient digestive secretions [38].

### 5. Discussion

*Katuka* having properties like *Lekhan* (Scraping), *Deepan* (restoration of *Agni*), *Pehchan* (removes toxins), *Bhedan* (Purgative), *Hridaya* (Cardioprotective), *Prameghna* (Anti-diabetic), *Yakrut Gana* (Hepato-protective) *karma* (Actions) which play major role in obesity [5].

#### 5.1 Tikta Rasa

Mainly *tikta rasa* having catabolic and absorbing effect on *meda* and it reduces the excess of *kleda* (Fat) in the body. It also decreases the *Medodhatu* (Excess of fat from the body). *Tikta rasa* has *sroto shodhan* property (channel cleaning). It absorbs the fluid and slimy material on account of *vayu* and thus vacating space (*saushirya*) due to *Aakash mahabhuta*. *Acharya Charaka* in *sutrasthan 26* has explained the properties of *tikta rasa* like *deepen* (restoration of *Agni*), *pehchan* (appetiser), *lekhan* (scraping), and *kleda meda upashoshan* (It reduces the excess of fat, lipid from the body) [4].

#### 5.2 Katu Vipaka

It has predominance of *Agni*, *vayu* and *aakash* *maha bhoota*. It is responsible for *medo dhatu kshay* (reduction in excessive *Medodhatu*).

#### 5.3 Laghu, Ruksha Guna

Due to its *laghu*, *ruksha guna* it pacifies increased *kapha*. These *gunas* help to reduce *Kapha* and *meda* which are the main responsible factors of *Hyperlipidemia* and thus potentiates their action by way of synergism. *Laghu Guna* produces *Laghutva* (decreases weight or bulk) and *Ruksha guna* produces *Rukshtva* (Dryness) in the body.

#### 5.4 Deepan, Pachan, Lekhan, Bhedan Karma

The *Katuka* has *tikta rasa* which stimulates the *jadhargni* and decreases the excess of *meda* by *deepan* property (restoration of *Agni*). Due to *katu Vipak* it digests the excess of *Aama* and *kleda* by *pachan* property (Digestion). It reduces the excess of *meda dhatu* by *Lekhan* property (Scraping). *Katuka* also shows *bhedan* (purgative) property due to its *Tikta Rasa* [4].

### 5.5 Medoghna (Anti-obesity Action)

In medorog, unnecessary deposition of *meda* (fat/adipose tissue) due to hypo-functioning of *Medodhatu* occurs. By the virtue of *Deepan-Pachan Karma*, *Katuka* increases *Agni* at all levels and it reduces *Ama* and corrects *Medodhatvagni Mandya*. Because of its *Lekhan* action, it helps to reduce *meda*. *Katuka* is one of the most important drugs mentioned in *Lekhaniya Mahakashaya*, which has choleric (*Pittavirechak*) and cholegogue-*Virechak* (purgative) action<sup>[39]</sup>. *Katuka* possesses Choleric action i.e. it increases bile production. It has cholegogue action which promotes flow of bile from gall bladder into the intestines. The bile salts are essential for absorption of fats and lipids from gut, thus the excretion of bile in feces leads to decrease absorption of fats, lipids in the gut hence concentration of lipids in serum is decreased.

### 5.6 Hridya (Cardioprotective) action

Improper diet & sedentary lifestyle leads to thickening of arteries resulting in obstruction (*Margavarod/Srotorodha*) in the normal pathway of *vayu*. *Vata* especially *vyanyayu* associated with *aam* (Contributing formation of athermanous plaque and thrombus) is involved in the pathogenesis of *Hridroga* (Cardiac disorders). *Katuka* establishes normalcy of *Agni* (metabolism) and *ras dhatwagni* (Tissue metabolism) and digests *Aam*. It eliminates morbid *doshas* through *bhedan* (piercing) and *Rechan* (purgative) action. Due to its *Lekhan* action and predominance of *Vayu & Aakash mahabhootas*, it successfully removes the obstruction (*Sanga/Srotorodhan*) in the *srotos* (channels of transportation of nutrients). Thus *katuka* plays an important role in the management of cardiac disorders.

### 5.7 Pramehaghna (Anti-diabetic action)

*Prameh* is *Tridoshaj* (involves all the three *doshas*) diseases. But initially it starts with derangement of *kapha dosha* due to prolonged and excess use of *kapha* provoking *aahar* (diet) and *vihar* (life style) leading to vitiation of *kapha* (*Bahudrava kapha*) which has basic resemblance with characteristic of *meda*. Both *Kapha* and *meda* interact with each other. Vitiating *kapha* further interact with *mansa* and produces *prameha pidika* and association of vitiating *Kapha* with *kleda* converts *kleda* into *mutra* (urine) resulting frequent urination. *Tikta rasa, katu vipak, ruksha & laghu guna* alleviates *kapha* which is the predominant *dosha* in the pathogenesis of *Prameh*. *Katuka* helps to correct *Medodhatavagnimandya* (tissue metabolism) due to its *deepan* and *pachan* activities. *Tikta rasa* and *ruksha guna* of *Katuka* help to absorb *kleda* and clears the channels. Thus *Katuka* possesses significant place in the treatment of *Prameh*.

### 5.8 Yakrut Gana (Useful in hepatic disorders)

*Katuka* is a very common plant used in *Ayurveda* mainly for liver disorders and gallstones. It stimulates liver and relieves its inflammation due to its *deepan* (corrects metabolism) and *Aampachan* (removes toxins from liver) *karma* (action). It is also useful in gall stones on account of its *bhedan* (piercing) and *rechan* (purgative) action. Moreover it is *pittasravi* (choleric) and *Pittavirechak* (chologogue).

The research work reveals that the anti-obesity, cardioprotective, anti-diabetic and hepatoprotective actions are pharmacologically evaluated for its efficacy.

### 6. Conclusion

*Katuka* (*Picrorhiza kurroa*) has the *deepan* (restoration of

*Agni*), *pachan* (Digection), *lekhan* (Scraping) and *Bhedan* (purgative) properties. *Picrorrhiza kurroa* possesses *tikta rasa, sheeta Virya, katu vipak, laghu and ruksha guna*. It has predominance of *vayu* and *aakash mahabhutas*. Due to all these virtues, it reduces the excess of *kleda, meda* from the body (lipid, fat reduces). In addition to this it has choleric (*Pittavirechak*) and cholegogue-*Virechak* (purgative) action which results in excretion of bile in feces leading to decrease in absorption of fats, lipids in the gut which results in the reduction in the concentration of lipids in serum. This explains its effectiveness in obesity. Moreover *Katuka* is beneficial in Obesity when it is associated with co-morbidities like Diabetes, Liver disease, Cardiac disorders and Cancer due to its *Hridya* (Cardio-protective), *Pramehaghna* (Anti-diabetic), *Yakrutvikarghna* (hepato-protective) action. The research work has revealed its Anti-obesity, Hypolipidemic, Cardioprotective, Anti-diabetic action, Hepatoprotective, Anti-cancer, Anti-oxidant, Anti-inflammatory and Immunomodulatory actions. Better randomized, double blinded, placebo-controlled clinical trials on *Katuka* are required which will attract the end users by effective benefits. This data will be surely useful for further scientific research.

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