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Literature review on Sri Lankan traditional formula in the management of obesity

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Abstract

Excess deposition of adipose tissue in the body is known as Obesity. World Health Organization cut-off values for Asians said that the percentage of Sri Lankan adults in the obese and centrally obese categories were 9.2% and 26.2%, respectively. Herbal drugs have been used in the treatment of *Staulya* since ancient times. The Sri Lankan traditional herbal formula consists of *Nigella sativa*, *Saussurea lappa*, *Zingiber officinale*, *Allium sativum*, *Cassia fistula* and *Cassia senna*. Mainly it has *Katu*, *Tikta*, *Madura rasa*, *Laghu*, *Ruksha*, *Ushna*, *Teekshna* and *Sara guna*, *Ushna veerya*, *Katu vipaka* and *Vata-Kapha shamaka guna* and *Virechaka karma*. Chemical composition of this formula as combination, has hypolipidemic activity and adipogenesis inhibition activity by reducing the fat absorption by bowels. Also it increases the bowel mortality and reduces the time of fat absorption. According to that the mentioned herbal formula is effective for the management of obesity related parameters.

Keywords: Obesity, *Staulya*, Sri Lankan traditional herbal formula, *Virechaka*

Introduction

Obesity is a metabolic disorder. Metabolism is a chemical processes in living beings which produces energy and growth (Debasis and Harry, 2004) ^[1]. The changes which occur in the digested food material, from the time of ingestion till the elimination in the form of excretion, the sum of total chemical changes which occurs within the body is to be considered as metabolism which yields energy and enriches growth. As obesity is deposition of fat in the body, it is justified to be under the heading of metabolic disorders (Field, *et al.*, 2001) ^[2].

Body mass index (BMI) is a simple index of weight-for-height that is commonly used to classify obesity in adults. It is defined as a person's weight in kilograms divided by the square of his height in meters (kg/m²). The World Health Organization (WHO) definition is BMI greater than or equal to 25 is overweight; a BMI greater than or equal to 30 is obesity; 30.0 - 35.0 - class I obesity; 35.0 - 40.0 - class II obesity; 40.0 - class III obesity and BMI \geq 35 or 40 kg/m² is severe obesity (WHO, 2015) ^[3].

Acharya Charaka mentioned that a person in whom excessive and abnormal increase of *Medodhatu* along with *Mamsadhatu* is found which results into pendulous appearance of buttocks, belly and breasts and whose increase bulk is not matched by a corresponding increase in energy is called *Sthula Purusha* (Obese) (Kashinath and Gorakhnath, 2011) ^[4].

For the purpose of diagnosis, prognosis and easy management disease should be classified as per severity as well as chronicity. Hence, classification of *Sthaulya* is essential but there is no such clear classification is found in *Ayurveda* classics.

Studies from Sri Lanka show a prevalence rate of 25.2% for overweight and 9.2% for obesity. The prevalence of central obesity among elderly was highest at 26.2%.

In addition, female sex, urban living, higher education, higher income and being in the middle age were shown to be associated with overweight and obesity in Sri Lankans. Relatively high prevalence of overweight and obesity, particularly, abdominal obesity among adults in Sri Lanka. Urgent public health interventions are needed to control the problem at an early stage (Taki, Kinimura and Sato, 2008) ^[5].

In *Ayurveda* literature, various *acharyas* have mentioned so many aetiological factors of overweight and obesity. The heredity component (*Bijadosha*) besides Food, and Psychological factors in causation of overweight and obesity have been described by *Acharya Charaka*. They are mostly exogenous types, but endogenous type of cause has been mentioned by *Acharya Sushruta* and *Acharya Vagbhata* (Jayasena and Dissanayake, 2020) ^[6].

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Review on Ola leaves manuscript

Ola leaf is a palm leaf used for writing in traditional palm leaf manuscripts and to write traditional drug prescriptions in Sri Lanka. The leaves are from the talipot tree, a type of palm, and fortunes are written on them and read by fortune tellers.

This *Ola* leaf manuscript belongs to the traditional Doctor A. Ranatunga and he got this manuscript from his grandfather. His grandfather was born nearly in 1850 and this manuscript is a traditional heritage of their family. Nearly this *Ola* leaf manuscript may be written in 1800 according to the archeological assessment (Archiological Dep. Panduwasnuwara, 2017). Fever, hemorrhagic disorders, Allergic rhinitis, metabolic disorders, bronchial asthma, obesity etc mainly can be identified according to drug formula mentioned in this Palm leaf manuscript. The language is mostly in verse form in this *Ola* leaf manuscript and the both sides used. Mainly there were about 200 drug formulas. Other hand the formulas, there were introduction some of diseases by their sign and symptoms, and there were definitions on them in Sanskrit terms too.

Materials and methods

This research was designed to find out the antiobesity activity of Sri Lankan traditional formula as a literature survey.

Review on Sri Lankan traditional herbal formulation

1. *Saussurea lappa*
2. *Zingiber officinale*
3. *Allium sativum*
4. *Cassia fistula*
5. *Cassia senna*
6. *Nigella sativa*

Saussurea lappa (Suwanda Kottan)

Family: Asteraceae

Latin Name: *Saussurea lappa*

Synonyms: *Kushtha*

English: Indian Costus root

Sinhala: *Suwanda Kottan*

There are 300 known *Saussurea* species. Among them, *Saussurea lappa* (*S. lappa*) is a representative perennial herb, globally distributed across Himalaya region. It belongs to Asteraceae Family, Sanskrit name is *Kushtha*, English name is Indian Costus root and Sinhala name is *Suwanda Kottan*. Used Part of *S. lappa* is Roots. *S. lappa* has been traditionally used in medicines without obvious adverse effects (Chen, Li and He, 1994) [7]. Phytochemical compounds isolated from this plant such as costunolide, Isodihydrocostunolide, cynaropicrin, Costunolide, Dihydrocostunolide, Dihydrocostus, Lactone, Lappadilactone, Mokko Lactone, Betulinic Acid, Cynaropicrin, Reynosin, Alantolactone, Anthraquinones, Alkaloids and Flavonoids were proven to be bio-active and potential source for developing new molecules (Chen *et al.*, 1995) [8].

It is popularly known as Kuth root or costus and used in various traditional system of medicine for its anti-ulcer, anti-convulsant, anti-cancer, hepatoprotective, anti-arthritis, anti-viral activities. Several of its activities are well proved and established through *in-vitro*, *in-vivo* methods which gave a rationale scientific approach to the traditional claims. Due to the significant proven activities *Saussurea lappa* is having considerable chance for new drug discovery (Cho, *et al.*, 2005) [9]. Despite significant progress in phytochemical and biological analyses of *S. lappa* over the past few years, inclusive and critical reviews of this plant are anachronistic or

quite limited in scope. *Saussurea lappa* (Asteraceae), syn *Aucklandia lappa* and *Saussurea costus*, is a well-known herbal medicine that has been used for treating various ailments, such as inflammatory and gastrointestinal diseases. Some research examined the anti-obesity effect of *S. lappa* extract (SLE) in adipocytes and high fat diet (HFD)-induced obese mouse model (Choi, *et al.*, 2005) [10]. SLE significantly inhibited the differentiation from pre adipocytes to adipocytes of cultured in dose-dependent manner. In addition, SLE significantly decreased the body weight gain and the food efficiency ratio of mice fed HFD during 9 weeks. Some results revealed that *S. lappa* suppresses the adipogenesis in cultured cells and the obesity in rodent models (Upadhyay, *et al.*, 1993) [11]. It also Hypolipidaemic, reduce serum cholesterol and serum triglycerides has antifungal, Antidiabetic, Antitumor, Antimicrobial and Antihepatotoxic activities. Therefore, *S. lappa* may be useful toward the development of new potent anti-obesity drugs.

Zingiber officinale (Inguru)

Family: Zingiberaceae

Latin Name: *Zingiber officinale*

Synonyms: *Nagara*

English: Ginger

Sinhala: *Inguru*

Used Part: Rhizome

Ginger (*Zingiber officinale* Rosc.) belongs to the family Zingiberaceae. It originated in South-East Asia and then used in many countries as a spice and condiment to add flavor to food. Besides this, the rhizome of ginger has also been used in traditional herbal medicine. The health-promoting perspective of ginger is attributed to its rich phytochemistry. Jolad *et al.* grouped fresh ginger into two wide range categories, i.e. volatiles and non-volatiles. Volatiles include sesquiterpene and monoterpenoid hydrocarbons providing the distinct aroma and taste of ginger. On the contrary, non-volatile pungent compounds include gingerols, shogaols, paradols, and zingerone. *Zingiber officinale* Roscoe has been used as a folk medicine in China. It has hypolipidaemic, antidiabetic and anti-oxidant activities due to 3826A>G and Trp64Arg polymorphisms of uncoupling protein 1 and β 3-adrenergic receptor genes and Blood pressure-lowering effect through blockade of voltage dependent calcium channels.

An aqueous extract of *Z. officinale* Roscoe inhibited the hydrolysis of triolein emulsified with phosphatidylcholine by pancreatic lipase *in vitro* and it reduced the elevation of rat plasma triacylglycerol levels 1 and 2 h after oral administration of a lipid emulsion containing corn oil. These results suggest that the aqueous extract of *Z. officinale* Roscoe might inhibit the intestinal absorption of dietary fat by inhibiting its hydrolysis. Some studies investigated the antiobesity effects of the aqueous extract of *Z. officinale* Roscoe by feeding a high-fat diet to mice for 8 weeks. Body weights at 2-8 weeks and final parametrial adipose tissue weights were significantly lower in mice fed the high-fat diet containing 3% aqueous extract of *Z. officinale* Roscoe than in the controls fed the high-fat diet. Feeding a high-fat diet containing 1% aqueous extract of *Z. officinale* Roscoe also significantly reduced final parametrial adipose tissue weights that were elevated in mice fed the high-fat diet alone. Impaired insulin-stimulated glucose metabolism is a common feature in obese and diabetic subjects. It is well established that insulin resistance in peripheral tissues is tightly associated with elevated circulating lipids and tissue lipid

accumulation. The mechanism studies showed that excessive free fatty acid and fatty acid oxidation inhibited glucose transport into peripheral tissues, the first rate-limiting step in glucose metabolism also.

Allium sativum (Sudu loonu)

Family: Liliaceae

Latin Name: *Allium sativum*

Synonyms: *Rasona*

English: Garlic

Sinhala: *Suduloonu*

Used Part: Rhisome

Allium sativum which belongs to Liliaceae Family, Sanscrit name is *Rasona*, English name is Garlic and Sinhala name is *Suduloonu*. Used Part of Garlic is a Rhisome that strongly aromatic bulb crop that has been cultivated for thousands of years. It is renowned throughout the world for its distinctive flavor as well as its health-giving properties. Bulb is rounded, composed of up to about 15 smaller bulblets known as cloves. Cloves and bulbs are covered by a whitish or pinkish tunic (papery coat). It contains, Alliin, Carbohydrates, Vitamins (folic acid, Niacin, Riboflavin, thiamine, vit c), Amino acids (aric, Asparagic acid, methionine, enzymes (allinase) volatile compounds, Thioglycosides, prostaglandins A₂, D₂, E₂ and F₂ Allylmethylselenide and Ajoene proteoruboside B (Adler and Beuchat, 2002) [12].

These effects have been largely attributed to reduction of risk factors for cardiovascular diseases, reduction of cancer risk, antioxidant effect, antimicrobial effect, and enhancement of detoxification foreign compound and hepatoprotection. Raw garlic possesses a beneficial potential in reducing cholesterol and triglycerides in diabetic rats. Administration of raw garlic to fructose fed rats significantly reduced serum glucose and insulin levels. The values of total cholesterol, Triglyceride and low density lipoprotein were significantly decrease in groups received garlic extract comparing with control and hypocholesterolic groups with non-significant increase in high density lipoprotein (HDL) in all groups have also been reported. The ethanolic extracts of garlic had been proved showing anti-hypercholesterolemic effect (Ademiluyi, *et al.*, 2013) [13] carried out a study to investigate the ameliorative effect of dietary inclusion of garlic (*Allium sativum*) on gentamycin-induced hepatotoxicity in rats and this showed significant reduction in total cholesterol and Triglyceride level. The study on hyperlipidemic guinea pig of both species of garlic (*A. sativum*, *A. tuberosum*) showed significant hypolipidemic activity as they reduced serum cholesterol, triglyceride, LDL. A research was performed a study to know the influence of garlic alcoholic extract on lipid profile upon simultaneous intake of ezetimibe which showed significant hypolipidemic activity. Oral garlic supplementation may be effective in decreasing serum cholesterol levels as much as 15% to 20% (Allison, *et al.*, 2012) [14].

Cassia fistula (Ehela)

Family: Caesalpinioideae

Latin Name: *Cassia fistula*

Synonyms: *Aragvada*

Sinhala: *Ehela*

Used Part: Fruit

Cassia fistula is belongs to Caesalpinioideae Family, Sanscrit name is *Aragvada*, Sinhala name is *Ehela* and used part is Fruit. It contains Aspartic acid, Glutamic acid, Lysine,

Vermolic, Fistulic Acid, Rhein, Rheinglucoside, Galactomannan, Sennosides A and B, Tannin, Phlobaphenes, Oxyanthraquinone Substances, Emodin, Chrysophanic Acid, Fistuacacidin, Barbaloin. *Cassia fistula* evaluated for their hyperlipidemic activity in diet-induced lipidemia in mice. Preliminary phytochemical screening was performed following standard procedure (Guru Prasad, Kuntal and John, 2015) [15].

It contains various types of constituents such as rhein, triterpenes, sugar, and potassium. Studies based on the animal model have confirmed that *C. fistula* and their constituents shows a role in diseases management via modulation of biological activities. Results demonstrated that *C. fistula* extracts can significantly lower body weight of mice in the treatment groups. In addition, parametrial fat weight of mice was also decreased in a dose-dependent manner, thus confirming the weight lowering potential of these plants.

Cassia senna (Senehe Kola)

Family: Fabaceae

Latin Name: *Cassia angustifolia*

Synonyms: *Hema*

English: Senna

Sinhala: *Senehe kola*

Used Part: Leaves

Cassia senna is belongs to Fabaceae Family, Sanscrit name is *Hema*, English name is Senna, Sinhala name is *Senehe kola* and used Part is Leaves. It contains Flavenol (Isorhamnetin, Kaempfeol), Anrathquinone Sennoside A, Sennoside B, Menitol, Sodium, Potassium tartarte, Salisilic acid, Crisophenic acid Volatile oils, Resins, Calcium oxalate. In traditional medicine, the plant is used as antimicrobial, antiviral, antibacterial, anti-inflammatory, antitrypanosomal and antioxidant agent, as a strong purgative, diuretic, abortifacient, anti-schistosomiasis, anti-dysentery and antihemorrhoid. Senna is a natural product that contains sennosides, which are active components that affect the intestinal tract and induce diarrhea. The ethanolic extract of *Cassia senna* leaves at 200 and 400 mg/kg/orally (from the end of 6th week up to 12th weeks) showed reduction in weight gain, feed intake (GM) feed intake (k/Cal) BMI, WH Ratio, obesity index and significant decrease in serum glucose, Triglyceride, Total cholesterol, LDL, VLDL and increase in HDL level, and also significantly decreased body fat depots and oxidative stress.

6. Nigella sativa (Kaluduru)

Family: Apiaceae

Latin Name: *Nigella sativa*

Synonyms: *Kalajagi*

English: Black Cumin

Sinhala: *Kaluduru*

Nigella sativa is a traditional medicinal plant used to treat various ailments in earlier days (Han, Kimuda and Okuda, 2005) [16]. Sanscrit name of it is *Kalajagi* and English name is Black Cumin. Used Part of *Nigella sativa* is Seeds. Nigellin, Cymine, Nigellone, Carvone, Limonene, Nigellimine and Thymoquinone are the active chemical compounds of *Nigella sativa* (Hasani, *et al.*, 2009) [17]. It has Cardio-protective, Anticancer, Antidiabetic, Antioxidant and Immune-modulatory actions (Datau, *et al.*, 2010) [18]. The seeds of this plant has high potential effect on diseases like cancer and it shows high antioxidant and ant lipid activities due to the presence of phytochemical thymoquinone. *Nigella*

Sativa showed a significant weight loss and reduced waist circumference with a mild reduction in fasting blood sugar, triglycerides and low-density lipoprotein levels (Hasani, *et al.*, 2009) [17].

Anti-obesity mechanisms for herbal plants included reduction in lipid absorption, reduced energy intake, increased energy expenditure, decreased pre-adipocyte differentiation and proliferation, or decreased lipogenesis and increased lipolysis. Decreased energy intake from the gastrointestinal tract is caused by acting on pancreatic lipase. *Nigella Sativa* showed strong inhibitory activity against pancreatic lipase, which led to weight loss (Datau, *et al.*, 2010) [18]. A significant weight loss and reduced waist circumference with a mild reduction in

fasting blood sugar, triglycerides and low-density lipoprotein levels. A systematic review on medicinal plants useful in diabetes mellitus showed that some herbal plants possess anti-hyper lipidemic effects, and this property is statistically significant in the treatment of obesity.

Nigella sativa oil, when used as on therapy proved effective in reducing weight, HDL-cholesterol and blood glucose levels. The most important action of *Nigella sativa* that may be responsible for its beneficial effect in metabolic syndrome is its insulin sensitizing action. *Nigella sativa* oil has significant favorable effects on hyperglycemia and dyslipidemia (Basu., *et al.*, 2011) [19].

Table 1: Ayurveda Properties of Herbal Formula

Drug	Rasa	Guna	Veerya	Vipaka	Karma
<i>Nigella sativa</i>	Katu Tikta	Laghu Ruksha	Ushna	Katu	Vatakapha Shamaka Deepana
<i>Zingiber officinalis</i>	Katu	Guru Ushna	Ushna	Madhura	Kapha Shamaka Bhedini
<i>Saussurea lappa</i>	Tikta Katu Madhura	Ruksha Laghu Teekshna		Ushna	Katu Deepana Pachana Triptighna Kapha shamaka
<i>Allium sativum</i>	Katu Madhura Lavana Tikta Kashaya	Guru Snigdha Teekshna Sara		Ushna	Katu Kaphavatashamaka Deepana Pachana Amadoshahara
<i>Cassia fistula</i>	Madhura	Mrudu Guru Snigdha		Sheetha	Madhura Kapha-Pitta shamaka Virechana
<i>Cassia senna</i>	Katu Tikta Madhura	Guru Ruksha Teekshna		Ushana	Katu Sukha Virechaka Pitta shodhaka Vata anulomaka

Results and discussions

The new herbal formula consists of *Nigella sativa* (*Kaluduru*), *Saussurea lappa* (*Suvanda Kottan*), *Zingiber officinale* (*Inguru*), *Allium sativum* (*Sudu lunu*), *Cassia fistula* (*Ehela*) and *Cassia senna* (*Senehe kola*). Some previous studies showed that some *Panchakarma* therapy like *Virechana* helped to manage diseases like *Sthaulya* and has hyperlipidemic activity too (Dissanayake and Tiwari, 2008)²⁰. When analyzing the new herbal formula, mainly it has *Katu*, *Tikta*, *Madura rasa*, *Laghu*, *Ruksha*, *Ushna*, *Teekshna* and *Sara guna*, *Ushna veerya*, *Katu vipaka* and *Vata-Kapha shamaka*, *Virechaka karma*. So, literature findings revealed that the new herbal formula has *Kapha* reducing and *Virechana* activity. Mode of action of the selected drug formula consists of many ingredients which excellently balance each other in Cardio-protective, Anticancer, Anti diabetic, Antioxidant, Immune-modulatory and Lipid lowering properties. So, it helpful to control fat volume in obese patients. According to the analysis of the chemical composition of new herbal formula as a combination, it has hypolipidemic activity and adipogenesis inhibition activity by reducing the fat absorption by bowels. Also, it increases the bowel mortality and reduces the time of fat absorption. The properties of those drugs have *Virechana* and weight lowering activity according to the modern and ancient literature.

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