“Experimental Evaluation of *Amomum subulatum* roxb. Seed extract on Diet Induced Metabolic Disorders In Rats”

**Introduction of Metabolic syndrome**

**Definition of metabolic syndrome**

Metabolic syndrome was identified first in adults by Reaven\(^1\) as a series of abnormalities that tended to coexist in patients who have insulin resistance. The cluster of symptoms has been variously labeled as syndrome X, insulin resistance syndrome, or dysmetabolic syndrome. Slightly differing definitions of metabolic syndrome are being used by different health organizations. In the concept proposed by WHO, insulin resistance is the underlying cause of metabolic syndrome, and so insulin resistance or glucose intolerance is required for its diagnosis.\(^2,3\) In the National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) definition, however, insulin resistance is not required for the diagnosis of metabolic syndrome. A diagnosis of metabolic syndrome is established when at least 3 of the following criteria are present: abdominal obesity, high levels of triglycerides, low levels of high-density lipoprotein (HDL) cholesterol, hypertension, and increased fasting glucose. Building on the NCEP and WHO definitions, the International Diabetes Federation (IDF) has recently proposed a new definition for metabolic syndrome, which requires a diagnosis of central obesity, and two of the following: raised triglycerides, reduced HDL-cholesterol, raised blood pressure (BP), or raised fasting plasma glucose. Currently, the NCEP ATP III definition is the most widely used criterion for diagnosing metabolic syndrome. It is applicable to routine clinical practice and quantifies variables that are easily measurable.

**Prevalence of metabolic syndrome**

Metabolic syndrome is a common health problem around the world. According to a new report from the third national health and nutrition examination survey, 25% of the adult American population meets the diagnostic criteria of metabolic syndrome.\(^4\) The percentage increases to 44% if only Americans over fifty years old are considered.\(^2,5\) The DECODE (Diabetes Epidemiology: Collaborative analysis of Diagnostic criteria in Europe) study found that 31% of men and 34% of women have metabolic syndrome in the European population. Currently, the incidence of metabolic syndrome in youth is also increasing. An investigation that analyzed data from 1988-1992 and from 1999-2000 found that the prevalence of metabolic syndrome in youth had increased from 4.2% to 6.4% in these short time periods. Another investigation which analyzed data from the third National Health and Nutrition...
Examination Survey (1988-1994) using the NCEP (ATP III) diagnostic criteria showed that the overall prevalence of the metabolic syndrome among adolescents aged 12 to 19 years was 4.2% and the syndrome was present in 28.7% of overweight adolescents (body mass index \( \geq 95\text{th percentile} \)).\(^6\) All these studies indicate that metabolic syndrome is becoming a common health problem that affects both adolescents and older people of our society.

**Metabolic syndrome and cardiovascular diseases**

Patients with metabolic syndrome are at increased risk for developing cardiovascular disease.\(^5,7,8\) Epidemiological studies have shown that metabolic syndrome predicts the development of cardiovascular morbidity and mortality\(^9,10\) and patients with metabolic syndrome have a three-times greater risk of coronary heart disease and stroke than those without the syndrome. Metabolic syndrome has been found to be an important predictor of subclinical heart dysfunction in patients without overt cardiovascular disease. Among individuals with no previous cardiovascular disease, cardiovascular mortality increased much faster in those with metabolic syndrome than in those without, and increased prevalence of coronary heart disease was found among adults over 50 years of age with metabolic syndrome.\(^5\) In the peripheral vessels, components of metabolic syndrome such as hypertension, hyperlipidemia and insulin resistance are associated with the development of endothelial dysfunction.

**Insulin resistance: the link between metabolic syndrome and type 2 diabetes**

Metabolic syndrome and type 2 diabetes are closely linked. Data from the San Antonio Heart Study show that metabolic syndrome is a stronger risk factor for diabetes than it is for cardiovascular diseases. Patients with metabolic syndrome are four times more likely to develop diabetes than those without the syndrome but twice as likely to develop cardiovascular disease. In patients with type 2 diabetes, the prevalence of the metabolic syndrome is as high as 75.6%.\(^11\) Currently, there is sufficient evidence that insulin resistance is an important link to the development of metabolic syndrome and type 2 diabetes.

Insulin resistance refers to a decrease in the biological and physiological response to insulin, resulting in over-secretion of insulin to compensate for the impairment of glucose transport in skeletal muscle and fat cells.\(^12,13\) Insulin resistance is a common abnormal condition present in both metabolic syndrome and type 2 diabetes. Studies have demonstrated that hyperinsulinaemia, which develops in response to insulin resistance, precedes the
development of type 2 diabetes.\textsuperscript{14,15} There is evidence which shows that abnormalities of metabolic syndrome, namely, obesity, hyperlipidemia and hypertension are all associated with the development of hyperinsulinemia and insulin resistance. For example, it has been found that basal and total 24-hour rates of insulin secretion are 3-4 times higher in obese subjects compared with non-obese subjects\textsuperscript{16} and visceral/subcutaneous adiposity is associated with the development of insulin resistance.\textsuperscript{17} Hypertension is prevalent in obesity and in type 2 diabetes, both of which are associated with insulin resistance. Various prospective and cross-sectional studies have documented a correlation between insulin resistance, hyperinsulinaemia and elevated BP.\textsuperscript{18,19,20} Abnormality in vascular activity in the presence of insulin resistance is one of the main mechanisms that lead to elevated BP in these conditions. It has been shown that impaired brachial artery reactivity and endothelial dysfunction are associated with increased severity of insulin resistance.\textsuperscript{21} Lipoprotein abnormalities in diabetes and metabolic syndrome consist of increases in plasma levels of triglycerides, apolipoprotein B (apo B), and small dense LDL particles, with marked reductions in plasma levels of HDL-C (including HDL\textsubscript{2}-C) and apo A-I.\textsuperscript{22} The presences of these characteristics have been associated with insulin resistance.\textsuperscript{23,24} Studies also showed that healthy subjects with increased visceral adiposity and insulin resistance have elevated plasma levels of triglycerides, sdLDL, and apo B. In addition, subjects with an elevated total cholesterol/HDL cholesterol ratio were found to have higher systolic and diastolic BPs, in addition to being insulin-resistant, glucose-intolerant and hypertriglyceridemic. All these findings suggest that insulin resistance is associated with type 2 diabetes, obesity, primary hypertension and dyslipidemia. In the state of insulin resistance, hyperinsulinemia is the result of increased amounts of insulin secreted by β cells in the pancreas. Progressive deterioration of the metabolic state results in eventual failure of endogenous hyperinsulinemia to compensate fully for the insulin resistance, thereby causing impaired glucose tolerance, and ultimately diabetes.\textsuperscript{25,26}

**Herbs used for metabolic disorder**

1.  Azadirachta indica: Nim or Neem (Hindi)
2.  Artemisia pallens: Davana
3.  Amomum subulatum: Badi illichi, Great Cardamom
4.  Beta vulgaris: Chukkander (Hindi), Garden beet(English)
5. Areca catechu: Supari (Hindi), Betelnut (English)
6. Biophytum sensitivum: Lajjalu or Laksmana (Hindi)
7. Bombax ceiba: Semul (Hindi) and Red Silk Cotton Tree (English)
8. Brassica juncea: Rai (Hindi)
9. Capparis decidua: Kurel or Pinju (Hindi) and Caper plant (English)
10. Caesalpinia bonducella:
11. Cajanus cajan: Tuvar (Hindi) and Red gram or Pigeon pea (English)
12. Coccinia indica: Bimb or Kanturi (Hindi) and Ivy Guard (English)
13. Eugenia uniflora: Pitanga and Surinam cherry (Vernacular)
14. Gymnema sylvestre: Gudmar or Merasingi (Hindi) and Periploca of the woods (English)
15. Trigonella foenum graecum: Methi or Mutti (Hindi) and Fenugreek (English)
16. Swertia chirayita: Chirata (Hindi)
17. Syzygium cumini (Eugenia jambolana): Jamun (Hindi) and Black Berry (English)
18. Pterocarpus marsupium: Vijayasar or Bijasal (Hindi) and Indian Malabar (English)
19. Phyllanthus niruri: Jangli Amla (Hindi)
20. Punica granatum: Anar (Hindi) and Pomegranate (English)
21. Salacia oblonga: Ponkoranti (Vernacular)
22. Murraya koelingsii Kurry patta (Hindi) and curry leaf tree (English).
23. Musa sapientum: Kela (Hindi) and Banana (English)
24. Nelumbo nucifera: Kamal (Hindi) and Lotus (English)
25. Mucuna pruriens: Kavach (Hindi) and Cowitch (English)
26. Ocimum sanctum: Tulsi (Hindi) and Holy basil (English)
27. Picrorrhiza kurroa: Kutki (Hindi)
28. Ipomoea batatas: Sakkargand or Mitha Alu (Hindi)
29. Momordica cymbalaria: Kadavanchi and Athalaki (Vernacular)
30. Mangifera indica: Aam or Amb (Hindi) and Mango (English)
31. Momordica charantia: Karela (Hindi) and Bitter Gourd (English)
32. Morus alba: Shetut or Tut (Hindi) and White Mulberry (English)
Introduction to plant *Amomum subulatum* Roxb. 27,28,29,30

**Biological Source:** Drug consists of nearly ripe dried seeds of *Amomum subulatum* Roxb. Family *Zingiberaceae* retained in capsule till use.

**Regional and Other Names**

- Bengali: *Bara-elachi, Baro-elach*;
- English: *Large or Greater Cardamom, Nepal Cardamom*;
- Gujarati: *Moti elaichi, Moto-elachi*;
- Hindi: *Bari-elachi, Bari-ilaichy*;
- Kannda: *Dodda-yalakki, Doddu-yaelakka*;
- Malayalam: *Chandrabala, Paeraelam, Peri-elav*;
- Marathi: *Mote veldode, Moto-eldori*;
- Oriya: *Bada-alaicha*;
- Tamil: *Periya-aelakkaai, Periyayelam*;
- Telugu: *Adavi-ellakkay, Peddayelakkaylu, Pedda-elakkay, Peddayelaki*

**Description:** An herb with leafy stem up to 90-100 cm in height. Leaves are oblong-lanceolate, bright green, glabrous on both surfaces. Flowers are white in globose shortly peduncle, spikes, bracts reddish brown, lip ovate-cuneate, emarginated, yellowish white. Filaments are very short, anther crest small, truncate, and entire. Fruits are reddish brown, densely echinate globose capsules. Seeds are many, held together by a viscid sugary pulp.

**Habitat:** This species is native to the Eastern Himalayas and inhabits cool forest areas near mountain streams and damp forest floors. Grows fast and vigorously during the summer monsoon months.

**Propagation:** By rhizome and seeds

**Chemical Constituents:** The seeds contain volatile oil, major constituent of V. oil is 1, 8-cineole. Other constituents are glycosides, petunidin, 3,5-diglucoside, and leucocyanidin and a new aurone glycoside, subulin, chalcone, cardamonin and a flavanone, alpinetin is also reported.
Ayurvedic Description:

Sanskrit name: Ela-brhat
Synonyms: Bhadraila, Sthulaila, Prthvlka
Properties:
- Rasa: Katu, tikta
- Guna: Laghu, ruksa, Tiksna
- Virya: Usna
- Vipdka: Katu
Actions: Kaphavatahara, pittavardhaka, sugandhi, dipana, pacana, visaghna, vamanahara

Therapeutic uses: Kandu, swasa, kasa, trusna, hrllasa, asyaroga, siroroga, vatarakta, oga, rakta dosa Vatahara, Kaphahara, Rocaka, Dipani, Mukhasodhaka, Angamardaprasmana.

Therapeutic Uses Mentioned in Ayurvedic Pharmacopoeia

The dried seeds are used in svasa (dyspnoea), kasa (cough), trusna (thirst), chardi (vomiting), mukharoga (diseases of the mouth), hrllasa (nausea), kandu (itching).