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Chapter 17

Critical Evaluation of Role of Ayurvedic *Kudhanyas* (Millets) In the Management of Obesity and diabetes Mellitus On the Basis of Glycemic Index and Nutritional Value

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Abstract

Background: Obesity (*Sthaulya*) and Diabetes Mellitus (*Madhumeha*) are major metabolic disorders with increasing global prevalence and constitutes a foremost public health challenge of the twenty-first century. Conventional pharmacological approaches carry significant side-effect burdens and do not address underlying dietary aetiology. Ayurveda recommends *Sushrutokta Kudhanyas* (millets) as therapeutic dietary components for treating these disorders. The ancient Ayurvedic treatise *Sushruta Samhita* classifies a distinct group of minor low-grade cereals under the denomination Kudhanyas (inferior grains / millets). Out of the fifteen inferior grains enumerated in Sushrut Samhita, four are specifically indicated for *Prameha* (diabetes), *Sthoulya* (obesity), and *Medoroga* (dyslipidaemia). These are *Kodrava* (Kodo millet - Paspalum scrobiculatum), *Shyamaka* (Barnyard millet - Echinochloa frumentacea), *Priyangu/Kangu* (Foxtail millet - Setaria italica), and *Sawa* (Little millet - Panicum sumatrense).

Objective: To critically evaluate the nutritional composition, glycemic index (GI), and Ayurvedic pharmacological properties of the four Sushrutokta *Kudhanyas* and assess their potential utility in the dietary management of obesity and DM in the light of classical Ayurvedic references and contemporary scientific evidence.

Methods: Classical Ayurvedic literature and contemporary scientific studies were critically analyzed, including international GI datasets and peer-reviewed research.

A systematic review of classical Ayurvedic texts particularly of Sushrut Samhita is done. For critically analysing the views of other authors Kudhanya related literature from *Charaka Samhita, Ashtanga Hridayam* and pharamacological lexicon ssuch as *bhavaprakasha Nighantu, Dhanvantari Nighantu, Raja Nighantu, Kaiyadeva Nighantu* is also discussed. Present study is also supplemented by a structured search of PubMed, Google Scholar, ICMR databases, and WHO/FAO sources for peer-reviewed studies on the nutritional composition and glycemic properties of these four millets published between 1990 and 2025.

Results: All four Sushrutokta *Kudhanyas* demonstrate glycemic indices in the low-to-medium range (GI: 40–58), compared to white rice (GI: 72–89) and wheat bread (GI: 70–75). Their high dietary fiber content (7.6–9.8 g/100g), elevated resistant starch levels (14–22%), rich polyphenolic profile (250–415 mg GAE/100g), and superior micronutrient density are consistent with their classical description as *Ruksha* (dry/desiccating), *Lekhana* (scraping/lipolytic), and Kaphapittahara (mitigating Kapha and Pitta doshas) in Ayurvedic literature. Modern studies confirm inhibition of α-amylase and α-glucosidase, reduction of postprandial glycaemia, antilipidaemic, and anti-inflammatory actions.

Conclusion: Based on convergent evidence from classical Ayurvedic references, nutritional data, and clinical research, the Sushrutokta *Kudhanyas — Kodrava, Shyamaka, Priyangu*, and *Sawa* — represent scientifically validated, safe, and culturally appropriate dietary interventions for the adjunctive management of obesity and diabetes mellitus.

Keywords: *Kudhanya*, Millets, Glycemic Index, *Madhumeha, Sthaulya*, Nutrition, *Kodrava, Shyamaka, Priyangu, Sawa*.

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1. Introduction

Epidemiology and Magnitude of the problem

Obesity and Diabetes Mellitus are categorized in Ayurveda under *Santarpanottha Vyadhis*, resulting from excessive caloric intake and sedentary lifestyle. Dietary regulation plays a pivotal role in their management. The global burden of diabetes is equally alarming. The Global Burden of Disease (GBD) Study 2021 estimated that approximately 529 million people were living with diabetes mellitus worldwide, with projections indicating an increase to 643 million by 2030 and 783 million by 2045 [1, 2]

India, China, and the United States collectively account for the highest absolute numbers of individuals with diabetes globally. The International Diabetes Federation (IDF) Atlas 11th Edition (2024) projects that the worldwide diabetes prevalence among adults aged 20–79 years will rise to 10.9–11.3%, with significant concentration in low- and middle-income countries, where 95% of projected increase by 2050 is expected to occur [3].

The obesity landscape in India is equally concerning. The World Obesity Federation assigns India a National Obesity Risk Score of 7/10, indicative of a high and growing burden [4]. Among adults aged 45 years and above, approximately four in ten are estimated to be at high risk of developing type-2 diabetes, with obesity and physical inactivity identified as primary modifiable risk factors [5]. Research demonstrates that modest weight reduction of 5–10% achieved through dietary changes and increased physical activity can reduce the incidence of type-2 DM by 40–60% in high-risk individuals [6]. Childhood obesity in India is projected to contribute 11% of the global paediatric obesity burden by 2030 [7].

Ayurvedic brief description of *Kudhanyas*

Sushruta Samhita, classifies millets under a distinct category — *Kudhanyas* — and attributes to them properties of *Ruksha* (dryness), *Laghu* (lightness), and *Lekhana Karma* (scraping/lipolytic action) that are considered directly antagonistic to the pathological accumulation of *Meda* (adipose tissue) and *Kleda* (abnormal moisture) characteristic of *Sthoulya* and *Prameha* [6, 8]

Modern nutrition emphasizes the importance of carbohydrate quality, particularly the glycemic index (GI), in regulating blood glucose levels. Millets (*Kudhanyas*), described in classical Ayurvedic texts, have recently gained scientific attention due to their low GI and high nutritional density. The pharmacological attributes like *Kaphapittahara* (mitigating Kapha and Pitta), *Medohara* (anti-lipidaemic) are collectively consistent with the modern understanding of millets' anti-obesity and antidiabetic mechanisms. With regard to lipid metabolism, phytosterols, policosanols, and insoluble dietary fibre in millets have been shown to reduce total cholesterol, LDL-cholesterol, and serum triglycerides while improving the HDL-C:LDL-C ratio, thus validating the Ayurvedic concept of Medohara (anti-lipidaemic) Karma [4].

2. Material and Methods

2.1. Review of Ayurvedic and Modern literature

This study employs a descriptive, analytical, and comparative research methodology constituting a critical review. Primary classical Ayurvedic textual data were gathered from authenticated scholarly editions of the *Sushruta Samhita* (Chaukhambha Orientalia, Varanasi, Reprint 2021), and the principal Nighantus (Bhavaprakasha, Raja Nighantu, Dhanvantari Nighantu, Kaiyadeva Nighantu). All Sanskrit verses were referenced with precise chapter and verse numbers. Modern literature was systematically reviewed from PubMed/MEDLINE, Google Scholar, Web of Science, Frontiers journals, and institutional databases of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), National Institute of Nutrition (NIN, Hyderabad), WHO/FAO, and the Indian Council of Medical Research (ICMR). Publications from 1990 to February 2025 were included. Nutritional data were sourced from the Indian Food Composition Tables (NIN-ICMR, 2017), ICRISAT databases, USDA FoodData Central, and peer-reviewed publications. Glycemic index values were sourced from the International GI and Glycemic Load (GL) Database (University of Sydney), published meta-analyses, and primary clinical trials.

2.2. Criteria for Glycaemic Index (GI) and Glycaemic Load (GL)

The glycemic index (GI) is a validated physiological measure of the blood glucose-raising potential of a food relative to a standard (glucose or white bread = 100 or 70 respectively). Foods with GI ≤ 55 are classified as low GI, 56–69 as medium GI, and ≥ 70 as high GI. The glycemic load (GL) integrates GI with carbohydrate content per serving, providing a more clinically relevant measure.

3. Review of Literature

3.1. Obesity & Diabetes – A Brief Synopsis

Obesity is defined by the WHO as abnormal or excessive fat accumulation that presents health risks, quantified by BMI $\geq 30\ \mathrm{kg/m^2}$ in international criteria ($\geq 25\ \mathrm{kg/m^2}$ for Asian populations). It results from a complex interaction of genetic predisposition, neuroendocrine dysregulation, environmental factors, and dietary patterns. Pathophysiologically, visceral adiposity drives insulin resistance through release of adipokines (TNF-α, IL-6, resistin) and free fatty acids that impair insulin signal transduction, precipitating hyperglycaemia and type-2 DM [5].

Diabetes mellitus Type-2 is characterised by progressive insulin resistance and relative insulin deficiency, resulting in chronic hyperglycaemia and long-term microvascular (retinopathy, nephropathy, neuropathy) and macrovascular (ischaemic heart disease, cerebrovascular disease, peripheral arterial disease) complications. India's unique 'Asian phenotype' — characterised by higher visceral fat, lower skeletal muscle mass, and earlier β-cell dysfunction renders the Indian population particularly susceptible to type-2 DM even at modest weight excess [9].

3.2. Ayurvedic Literature About Millets

Acharya Sushruta described *Kudhanyas* and its properties in his treatise 'Sushrut Samhita' in *Sutra Sthana* Chapter 46, verse no.21-24. Sushruta enumerated following *Kudhanyas* in the list. *Kordush, Shyamak, Nivar, Shantanu, Varaka, Uddalaka, Priyangu, Madhulika, Nandimukhi, Kuruvinda, Gavedhuka, Sara, Varuk, Todaparni, Mukundaka*. Further acharya sushruta mentioned that these *Kudhanyas* are warm, astringent, little sweet, dry, have *katu Vipaka , Kapha-hara* (which alleviated Kapha) [10].

Acharya Sushruta had suggested these *Kudhanyas* for the management of obesity and diabetes in the *sutra sthana* of his treatise Sushrut Samhita, chapter 15, verse no. 37 [11].

Acharya Vagbhata in *Ashtanga Hridayam* (Sutrasthana 6/11, 13) classifies millets as *Trinadhanya* within the broader *Shuka Dhanya Varga*. He specifically mentions *Kangu (Priyangu), Kodrava, Nivara, Shyamaka* and affirms that all of them are *Laghu* (light to digest), increase *Vata*, reduce *Kapha* and Pitta, and have *Lekhana Karma* — a scraping/fat-reducing action of profound relevance to the management of obesity and dyslipidaemia [12].

3.3. Modern Literature About Millets

Millets belong to the botanical family Poaceae and include a heterogeneous group of small-seeded annual grasses. The Sushrutokta *Kudhanyas* under review correspond to the following modern botanical identifications: Kodrava — Kodo millet (Paspalum scrobiculatum); Shyamaka — Barnyard millet (Echinochloa frumentacea); Priyangu/Kangu — Foxtail millet (Setaria italica L. Beauvois); and Sawa / Little millet (Panicum sumatrense Roth).

Nutritional Value of Millets

Millets are characterised by a nutritionally superior profile compared to major cereal staples such as polished rice and refined wheat. They are rich in complex carbohydrates, dietary fiber (including both soluble and insoluble fractions), resistant starch, protein (with better essential amino acid profiles than rice), fat (predominantly unsaturated fatty acids), and a dense micronutrient matrix including calcium, iron, zinc, magnesium, phosphorus, and B-vitamins [13].

Their polyphenolic content — including phenolic acids (gallic acid, ferulic acid, sinapic acid), flavonoids (luteolin, apigenin, quercetin), tannins, and proanthocyanidins — confers significant antioxidant, anti-inflammatory, and enzyme-inhibitory properties directly relevant to diabetes and obesity management [14, 15]

Millets and Glycemic Index Response

The four *Sushrutokta Kudhanyas* uniformly demonstrate low-to-medium GI values (40–58), compared to the high GI of polished white rice (72–89) and refined wheat bread (70–75) [16, 17]

Anti-Obesity & Anti-lipid Role of Millets

Anti-obesity and anti-lipidaemic mechanisms of millets are multifactorial. High dietary fiber content promotes satiety by slowing gastric emptying and suppressing appetite-stimulating hormones (ghrelin), while simultaneously increasing satiety hormones (GLP-1, PYY). Resistant starch serves as a prebiotic substrate for colonic fermentation, generating short-chain fatty acids (SCFAs — butyrate, propionate, acetate) that inhibit hepatic cholesterol synthesis, improve insulin sensitivity, and modulate inflammatory pathways [18].

Phytosterols in foxtail millet competitively inhibit cholesterol absorption at intestinal brush-border receptors, reducing LDL-cholesterol levels. Policosanols, particularly abundant in barnyard millet, have been demonstrated to inhibit HMG-CoA reductase — the primary enzyme target of statin drugs — thereby reducing hepatic cholesterol synthesis. The presence of phytochemicals like phenolics and proanthocyanidins further contributes to anti-obesity effects through inhibition of pancreatic lipase, prevention of fat absorption, and reduction of adipogenesis [14].

4. Observations

Table 1: Nutritional Composition of Sushrutokta *Kudhanyas* per 100g Edible Portion (Dry Grain) Compared with Reference Cereals

Nutrient (per 100g)	Kodo Millet (Kodrava)	Barnyard Millet (Shyamaka)	Foxtail Millet (Priyangu/Kangu)	Little Millet (Sawa)	White Rice (Reference)	Wheat (Reference)
Energy (kcal)	309	307	331	329	345	341
Carbohydrates (g)	65.9	65.5	60.9	67.0	78.2	71.2
Protein (g)	8.3	6.2	12.3	7.7	6.4	11.8
Fat (g)	1.4	2.2	4.0	4.7	0.5	1.5
Dietary Fiber (g)	9.0	9.8	8.0	7.6	0.2	1.9
Calcium (mg)	27	20	31	17	10	41
Iron (mg)	0.5	5.0	2.8	9.3	0.7	3.5
Magnesium (mg)	147	82	81	92	25	138
Phosphorus (mg)	188	280	290	220	130	306
Potassium (mg)	170	210	250	195	115	363
Zinc (mg)	1.4	3.0	2.4	2.0	1.1	2.7
Resistant Starch (%)	High (18–22)	High (16–20)	Moderate (12–15)	Moderate (14–18)	Low (2–4)	Low (2–3)
Total Polyphenols (mg GAE/100g)	320–415	290–380	280–350	250–330	40–60	80–110

Sources: National Institute of Nutrition (NIN-ICMR) Indian Food Composition Tables 2017; ICRISAT Grain Quality Database; Frontiers in Nutrition (Jacob et al., 2024); USDA FoodData Central, 2023. Values represent mean estimates; ranges may vary by variety, growing conditions, and processing method. GAE = Gallic Acid Equivalents.

Table 2: Glycemic Index (GI) and Glycemic Load (GL) of Sushrutokta *Kudhanyas* — Comparison Across Published Studies

Millet (Ayurvedic Name)	GI Value (Range)	GI Category	Glycemic Load (GL)	Key Studies / References
Kodo Millet – Kodrava (Paspalum scrobiculatum)	49–55	Low	15–18	Malavika et al. (2020); Anitha et al. (2021)
Barnyard Millet – Shyamaka (Echinochloa frumentacea)	40–50	Low	12–16	Mbithi et al. (2019); Anitha et al. (2021); ICRISAT
Foxtail Millet – Priyangu/Kangu (Setaria italica)	50–57	Low–Medium	14–19	Malavika et al. (2020); Patil et al. (2015)
Little Millet – Sawa (Panicum sumatrense)	52–58	Low–Medium	16–20	Patil et al. (2015); Anitha et al. (2024)
White Rice (Reference cereal)	72–89	High	29–37	WHO/FAO GI Database; Jenkins et al.
Wheat Bread (Reference cereal)	70–75	High	24–29	Atkinson et al. (2008); Foster-Powell et al.

Sources: Anitha et al., Front. Nutr. 2021; Malavika M et al., Indian J Med Res. 2020; Patil KB et al., J Food Sci Technol. 2015; Foster-Powell K et al., Am J Clin Nutr. 2002; Atkinson FS et al., Diabetes Care 2008; ICRISAT Reports 2019.
GI values expressed relative to glucose = 100. Low GI $\leq$ 55; Medium GI: 56–69; High GI $\geq$ 70.

Table 3: Ayurvedic Pharmacological Properties of Sushrutokta *Kudhanyas* and Their Modern Pharmacological Correlates

Millet (Sanskrit Name)	Rasa (Taste)	Guna (Quality)	Virya (Potency)	Vipaka (Post-digestive effect)	Karma (Action) – Disease Indication
Kodrava (Kodo Millet)	Kashaya, Madhura (Astringent, Sweet)	Ruksha, Laghu (Dry, Light)	Sheeta (Cold)	Katu (Pungent)	Kaphapittahara, Vatakara, Grahi; Prameha, Sthoulya, Medoroga
Shyamaka (Barnyard Millet)	Kashaya, Madhura (Astringent, Sweet)	Laghu, Ruksha (Light, Dry)	Sheeta (Cold)	Katu (Pungent)	Kaphapittahara, Lekhana; Madhumeha, Sthoulya, Atisara
Priyangu/Kangu (Foxtail Millet)	Kashaya, Madhura (Astringent, Sweet)	Ruksha (Dry), Guru (Heavy)	Ushna (Hot)	Katu (Pungent)	Kaphahara, Balya (strength-giving); Prameha, Raktapitta, Fracture healing
Sawa/Shyamaka variant (Little Millet)	Kashaya, Madhura (Astringent, Sweet)	Laghu, Ruksha (Light, Dry)	Sheeta (Cold)	Katu (Pungent)	Kaphapittahara, Lekhana; Prameha, Sthoulya, Santarpanajanya Vyadhi

Sources: Sushruta Samhita Sutrasthana 46/21-24; Charaka Samhita Sutrasthana 27/16-18; Ashtanga Hridayam Sutrasthana 6/11,13; Bhavaprakasha Nighantu Dhanya Varga 9/74-79; Raja Nighantu Shalyadi Varga 9/126-127. Classical property designations translated as per Dravyaguna literature.

5. Discussion

Charkokta list of *Kudhanyas* includes several millets *under Shukadanya Varga: Koradusha, Shyamaka, Hastishyamaka, Nivara, Gavedhuka, Priyangu, Mukunda, Varuka, Varaka*, among others.[13] Charaka (Sutrasthana 27/16–18) establishes the general properties of this group as *Kashaya-Madhura Rasa, Laghu* (light), *Vatakara* (Vata-aggravating), *Kaphapittahara* (mitigating Kapha and Pitta).[13] Charaka explicitly prescribes *Trindhanya* with Sasti rice and Sarshapa oil as *Pathya Ahara* in Prameha — an early evidence-based dietary prescription for diabetic management [19].

Analysis of the nutritional data in Table 1 reveals several key observations. First, all four millets demonstrate markedly higher dietary fiber content (7.6–9.8 g/100g) compared to polished white rice (0.2 g/100g) and even refined wheat (1.9 g/100g), conferring significant satiety-promoting and glycaemic-moderating advantages. Second, resistant starch content — a critical determinant of glycemic response and prebiotic function — is substantially higher in Kodrava (18–22%) and *Shyamaka* (16–20%) than in major cereals. Third, the total polyphenolic content (250–415 mg GAE/100g) of *Sushrutokta Kudhanyas* far exceeds that of rice and wheat, underpinning their antioxidant and enzyme-inhibitory properties. Fourth, foxtail millet (Priyangu) provides the highest protein content (12.3 g/100g) among the four, surpassing even wheat (11.8 g/100g) and substantially exceeding rice (6.4 g/100g), supporting its classical description as Balya (strength-giving) in Ayurveda.

The glycemic data in Table 2 demonstrate that all four *Sushrutokta Kudhanyas* fall within the low GI category (*Kodrava*: 49–55; *Shyamaka*: 40–50) or the low-to-medium boundary (Priyangu: 50–57; Sawa: 52–58). This is in stark contrast to polished white rice (GI: 72–89) and refined wheat bread (GI: 70–75), which qualify as high GI foods. The glycemic load values of the four millets (12–20 per serving) are similarly lower than those of white rice (29–37) and wheat bread (24–29), further substantiating their role in attenuating postprandial hyperglycaemia.

It is noteworthy that barnyard millet (*Shyamaka*) displays the lowest GI range (40–50) among the four, consistent with its highest dietary fiber content (9.8 g/100g) and elevated resistant starch fraction. Kodo millet (*Kodrava*) similarly demonstrates a low GI (49–55) alongside the highest resistant starch content (18–22%) and richest polyphenolic profile (320–415 mg GAE/100g), rendering it particularly suitable for diabetic dietary management. These findings are corroborated by the 2020 study by Malavika et al. (Indian Journal of Medical Research) which assessed GI of unpolished little millet and foxtail millet in healthy subjects and found GI values of 52–58, and by the 2015 study of Patil et al. which evaluated GI of little millet flakes (52.3) in comparison with high-GI breakfast cereals [20, 21].

A landmark systematic review and meta-analysis by Anitha et al. (2021), encompassing 80 studies in 11 countries and 4,702 participants (including individuals with diabetes, pre-diabetes, and healthy subjects), established that regular millet consumption reduced fasting blood glucose by approximately 12%, postprandial blood glucose by 15%, and HbA1c by approximately 0.5% compared to rice and wheat-based diets [16].

The Ayurvedic pharmacological framework for *Kudhanyas* finds remarkable translational resonance with modern nutritional and mechanistic evidence. Each key classical property can be mapped to a specific modern mechanism:

- ***Ruksha Guna* (Dryness):** The Ruksha (dry/desiccating) quality of millets reflects their low moisture content, minimal oily/unctuous component, and high fiber-to-carbohydrate ratio. In modern terms, this translates to the ability of millet dietary fiber and resistant starch to absorb water in the gastrointestinal tract, increase stool bulk, reduce Kleda (excess moisture), and decrease the bioavailability of simple sugars and lipids. These properties are mechanistically anti-adipogenic and anti-diabetogenic.
- ***Lekhana Karma* (Scraping/Lipolytic Action):** This classical concept, attributed to all Trinadhanya in Ashtanga Hridayam, refers to the capacity of a drug or food to scrape, remove, or reduce accumulated Meda (adipose tissue), Kapha, and *Kleda* from bodily channels. The modern correlate of Lekhana Karma encompasses inhibition of lipogenesis, promotion of lipolysis, reduction of total cholesterol and LDL-cholesterol, and anti-inflammatory action. Multiple studies confirm that regular millet consumption reduces serum triglycerides, total cholesterol, and LDL-C, while improving HDL-C — the precise biochemical signature of Lekhana Karma in lipid metabolism [15]. The high insoluble dietary fiber in millets binds bile acids in the intestinal lumen, promoting their faecal excretion and consequently increasing hepatic cholesterol conversion to bile acids — a well-established mechanism of dietary cholesterol reduction consistent with *Medohara Karma* (anti-lipid action)
- **Kaphapittahara Karma:** In Ayurvedic pathophysiology, both *Sthoulya* (obesity) and Prameha (diabetes) are classified as Santarpanajanya (diseases of over-nourishment) with Kapha-dominant and Pitta-contributory pathogenesis. The therapeutic principle is Apatarpana (depletion/reduction therapy) using *Ruksha*, Laghu, and Kaphahara foods and drugs. The Kaphahara property of millets thus directly addresses the pathogenic substrate. Modern mechanistic evidence supports this: millets reduce inflammatory cytokines (TNF-α, IL-6) that drive Kapha-type metabolic dysfunction, improve gut microbiota composition by promoting Lactobacillus and Bifidobacterium species (reducing proinflammatory Kapha-associated dysbiosis), and modulate the NF-κB inflammatory signalling pathway [18].
- ***Sheeta Virya* (Cold Potency) of Kodrava and Shyamaka:** The cold potency of Kodrava and Shyamaka, counterintuitive in the context of digestive function, may be interpreted as a Pitta-moderating property in the context of inflammatory hyperglycaemia. Modern evidence demonstrates that the phenolic acids and flavonoids in these millets exert significant anti-inflammatory (Pitta-mitigating) effects by reducing prostaglandin synthesis and inhibiting COX-2 pathways — consistent with their Pittahara classical designation.

Several landmark studies have generated quantitative evidence on the metabolic impact of Sushrutokta *Kudhanyas*. Vedamanickam et al. (2020, Biomedicine) conducted a clinical study comparing millet versus non-millet diets in diabetic subjects with metabolic syndrome and demonstrated significant reductions in fasting blood glucose, postprandial glucose, HbA1c, total cholesterol, LDL-cholesterol, and BMI in the millet group. Agrawal et al. (2023, Cureus) systematically reviewed evidence on millets as a dietary solution for diabetes mellitus and confirmed that the combination of low GI, high fiber, polyunsaturated fatty acids (PUFA), non-acid-forming potential, and gluten-free composition makes millets superior to refined cereal staples in diabetic dietary management [22].

With respect to Kodo millet (*Kodrava*), a 2018 clinical trial (n=60) comparing Kodo millet porridge versus rice porridge in pre-diabetic subjects demonstrated a 15% lower postprandial glucose elevation in the millet group over a two-week period, along with anecdotal improvements in satiety [23].

Studies on Barnyard millet (Shyamaka) confirm its anti-inflammatory and antioxidant activity through high DPPH free-radical scavenging capacity, attributed to its polyphenol content. The Shyamaka group exhibited significantly lower total cholesterol and triglyceride levels in animal models compared to high-fat diet controls.

Kumar et al. (2025, Food Safety and Health, Wiley) explored the molecular pathways of anti-diabetic effects of millets and found that millet consumption modulates gluconeogenesis and glycolysis, enhances glucose transporter (GLUT4) activity, increases leptin levels (promoting satiety), inhibits the NF-κB pathway (reducing chronic inflammation), and mitigates oxidative and nitrosative stress — a comprehensive mechanistic profile consistent with the multifaceted Ayurvedic description of *Kudhanyas* as *Pramehaghna* (anti-diabetic) and *Medohara* (anti-lipidaemic) foods [18].

6. Conclusion

Based on the convergent and mutually reinforcing evidence derived from classical Ayurvedic literature and peer-reviewed contemporary scientific research, it is concluded that the *Sushrutokta Kudhanyas* — specifically *Kodrava* (Kodo millet, Paspalum scrobiculatum), *Shyamaka* (Barnyard millet, Echinochloa frumentacea), *Priyangu/Kangu* (Foxtail millet, Setaria italica), and *Sawa* (Little millet, Panicum sumatrense) — are scientifically validated, nutritionally superior, and therapeutically relevant dietary interventions for the adjunctive management of obesity and diabetes mellitus.

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References

[1] GBD. Diabetes Collaborators. Global, regional, and national burden of diabetes from 1990 to 2021, with projections of prevalence to 2050: a systematic analysis for the Global Burden of Disease Study 2021. *Lancet*, 2023(402):10397, 2021. doi:10.1016/S0140-6736(23)01301-6.

[2] International Diabetes Federation. *IDF Diabetes Atlas*. IDF, Brussels, 10th edition, 2022.

[3] K. L. Ong, L. K. Stafford, S. A. McLaughlin, et al. IDF Diabetes Atlas Scientific Committee. Global, regional, and national burden of diabetes from 1990 to 2021. *Lancet*, 402:203–234, 2023. doi:10.1016/S0140-6736(23)01301-6.

[4] P. Jacob, V. Krishnan, S. M. Antony, et al. The nutrition and therapeutic potential of millets: an updated narrative review. *Front Nutr*, 11, 2024. doi:10.3389/fnut.2024.1346869. Article 1346869.

[5] D. L. Bhatt, K. Patel, and R. Mehta. Cardiovascular risk factors in metabolic syndrome. *J Am Coll Cardiol*, 81(12):1150–1164, 2023.

[6] Yadavji Trikramji Acharya, editor. *Sushruta Samhita*. Chaukhambha Orientalia, Varanasi, India, 2021. Sutrasthana, Adhyaya 46 (Annapana Vidhi Adhyaya), verses 21–25, pp. 215–217.

[7] V. Sethi, S. Bassi, D. Bahl, et al. Prevalence of overweight and obesity and associated demographic and health factors in India: findings from Comprehensive National Nutrition Survey (CNNS). *Int J Pediatr Obes*, 19(4):e13092, 2024. doi:10.1111/ijpo.13092.

[8] K. L. Bhishagratna. An English Translation of the Sushruta Samhita. 1:530–535, 1991. Chaukhamba Sanskrit Series Office.

[9] P. Mittal, M. Gupta, et al. Assessing type-2 diabetes risk based on the Indian diabetes risk score among adults aged 45 and above in India. *Sci Rep*, 15:4520, 2025. doi:10.1038/s41598-025-88460-z.

[10] Anant Ram Sharma, editor. *Sushruta Samhita of Maharshi Sushruta Volume 1,*. Choukhamba Surbharati Prakashan, Varanasi, India, 2008. Reprint edition; Sutrasthana 46/21, p. 389.

[11] Anant Ram Sharma, editor. *Sushruta Samhita of Maharshi Sushruta, Volume 1 (Sutra–Nidana Sthana)*. Choukhamba Surbharati Prakashan, Varanasi, India, 2008. Reprint edition; Sutrasthana 15/37, p. 127.

[12] Vagbhata. *Ashtanga Hridayam, Sutrasthana 6, Verses 11, 13*. Caukhamba Sanskrita Samsthana, Varanasi, 13th edition, 1994. Edited by Kashinath Shastri.

[13] National Institute of Nutrition. *Indian Food Composition Tables 2017*. ICMR-NIN, Hyderabad, India, 2017.

[14] P. Jacob, V. Krishnan, S. M. Antony, et al. The nutrition and therapeutic potential of millets: an updated narrative review. *Front Nutr*, 11, 2024. doi:10.3389/fnut.2024.1346869. Article 1346869.

[15] R. Kumar, K. Pramanik, M. Goyal, et al. Exploring the molecular pathways underlying the anti-diabetic effects of millets. *Food Saf Health*, 3:e70007, 2025. doi:10.1002/fsh3.70007.

[16] S. Anitha, R. Botha, J. Kane-Potaka, et al. Can millet consumption help manage hyperglycaemia and type 2 diabetes? A systematic review and meta-analysis. *Front Nutr*, 8:687428, 2021. doi:10.3389/fnut.2021.687428.

[17] M. Malavika, S. Shobana, P. Vijayalakshmi, et al. Assessment of quality of minor millets available in the south Indian market and glycaemic index of cooked unpolished little and foxtail millet. *Indian J Med Res*, 152(4):401–409, 2020. doi:10.4103/ijmr.IJMR_1579_18.

[18] R. Kumar, K. Pramanik, M. Goyal, et al. Exploring the molecular pathways underlying the anti-diabetic effects of millets. *Food Saf Health*, 3:e70007, 2025. doi:10.1002/fsh3.70007.

[19] Agnivesha. Charaka Samhita, Sutrasthana 27/16–18. In *Yadavji Trikramji Acharya, editor*, page 181. Chaukhamba Subharati Prakashan, Varanasi, 2016.

[20] M. Malavika, S. Shobana, P. Vijayalakshmi, et al. Assessment of quality of minor millets available in the south Indian market and glycaemic index of cooked unpolished little and foxtail millet. *Indian J Med Res*, 152(4):401–409, 2020. doi:10.4103/ijmr.IJMR_1579_18.

[21] K. B. Patil, C. V. Bharati, and I. Sunanda. Glycaemic index and quality evaluation of little millet (Panicum miliare) flakes with enhanced shelf life. *J Food Sci Technol*, 52(9):6078–6082, 2015. doi:10.1007/s13197-014-1663-5.

[22] B. R. Agrawal, U. Gajbe, M. A. Kalambe, and M. Bankar. Managing diabetes mellitus with millets: a new solution. *Cureus*, 15(9): e44908, 2023. doi:10.7759/cureus.44908.

[23] Planet Ayurveda Research Library. Paspalum scrobiculatum: Ayurvedic properties and clinical evidence review, 2025. URL https://www.planetayurveda.com/library/kodo-millet-paspalum-scrobiculatum. Updated January 2026.