Indian J. Applied & Pure Bio. Vol. 40(3), 1601-1608 (2025). **ISSN: 0970-2091**
A web of Science Journal

A study on the impact of Honey on Obesity-related characteristics in Rats fed a High-fat diet

[*1]Om Guptesh Sugandhi, [2]Girish Kumar Vyas and Nitin Nama[3]

[1,2]School of Pharmacy, Career Point University, Kota - 324005 (India)
[3]Lord Buddha College of Pharmacy, Ranpur, Kota - 325003 (India)
Corresponding Author: Om Guptesh Sugandhi, PG Scholar, School of Pharmacy, Career Point University, Kota - 324005 (India)

Abstract

This study investigates the impact of Pauttika honey, a type of honey classified in Ayurvedic texts as "heating" and fat-mobilizing, on obesity-related parameters in rats fed a high-fat diet. The research aims to bridge traditional knowledge with modern science by identifying the honey type, analysing its physicochemical and nutritional properties, and evaluating its therapeutic potential. Honey samples were collected from bamboo tree honeycombs, characterized through organoleptic, sensory, and advanced analytical techniques like FTIR and HPLC. Experimental evaluation involved the administration of Pauttika honey to high-fat diet-induced obese rats. Key parameters including blood glucose, lipid profile, liver and kidney function tests, and hormones such as leptin, resistin, and adiponectin were measured. Histopathological analysis of vital organs was also performed. Results showed significant improvement in metabolic and hormonal profiles, along with reduced weight gain and preserved organ histology in honey-treated rats. The study concludes that Pauttika honey possesses potent anti-obesity properties and can serve as a natural therapeutic agent. It calls for further clinical research to validate these effects in human populations and promote integration of traditional remedies into modern obesity management.

Key words : Pauttika honey, Obesity, High-fat diet, Ayurveda, Adiponectin, Leptin.

Obesity has emerged as a major global health concern, affecting millions of individuals across all age groups and leading to a host of chronic diseases such as type 2 diabetes, cardiovascular disorders, non-alcoholic fatty liver disease, and certain forms of cancer. It is a complex multifactorial condition characterized by excessive fat accumulation and associated with metabolic dysregulation, including altered lipid and

[1*]PG Scholar, [2]Associate Professor

glucose metabolism, hormonal imbalances, and systemic inflammation. The growing prevalence of obesity has prompted the search for effective and safe alternatives to synthetic anti-obesity drugs, many of which have adverse effects or limited long-term efficacy[1-3].

Traditional and natural remedies are gaining renewed interest due to their holistic benefits and lower risk profiles. Among these, honey, a natural product of bee activity, holds significant therapeutic potential. In Ayurveda, an ancient Indian system of medicine, honey is categorized into various types based on the source and characteristics. One such type is PauttikaMadhu, which is derived from specific bee species and is believed to possess unique medicinal properties, especially in metabolic disorders. Ayurveda describes Pauttika honey as heating in nature and effective in breaking down fat, improving digestion, and enhancing metabolism[4-5].

Modern scientific literature supports many of these claims, highlighting honey's antioxidant, anti-inflammatory, and lipid-lowering properties. It contains a rich composition of monosaccharides, polyphenols, flavonoids, enzymes, organic acids, and trace minerals that contribute to its medicinal value. Notably, honey has been shown to influence hormonal markers such as leptin, resistin, and adiponectin, which play crucial roles in appetite regulation, insulin sensitivity, and fat metabolism.Despite this, very few studies have investigated the comparative effects of specific types of Ayurvedic honey on obesity-related parameters using controlled experimental models. The present study aims to bridge this gap by evaluating the impact of Pauttika honey on obesity and associated biochemical and histological alterationsin a high-fat diet (HFD)-induced obesity model in rats[6-9].

This study was designed as an experimental investigation to evaluate the impact of Pauttika honey, as defined by Ayurvedic and modern standards, on various obesity-related parameters in rats subjected to a high-fat diet (HFD). The methodology involved the following key stages :

Honey collection and identification :

Honey samples were procured from honeycombs built on bamboo trees, using traditional methods in accordance with Ayurvedic practices. The honey was stored in airtight, sterilized glass containers at room temperature and protected from direct sunlight. The species of bees responsible for honey production were identified based on both classical Ayurvedic texts and modern entomological analysis. The collected honey was classified as Pauttika Madhu, traditionally known for its thermogenic and fat-metabolizing properties[10-12].

Physicochemical and nutritional Analysis:

Organoleptic and sensory evaluations were conducted using a hedonic rating scale, assessing color, aroma, taste, and consistency. Physicochemical tests included:

- Color measurement using a Hunter Color Lab.
- Moisture content determined via hot air oven method.
- pH, ash content, reducing sugar, and total phenolic content evaluations.

Advanced analytical techniques included:

- Fourier-transform infrared spectroscopy

(FTIR) for identifying functional groups and verifying purity.
- High-performance liquid chromatography (HPLC) to profile major sugars and bioactive compounds.

Experimental animal Design :

Thirty-six adult Wistar rats (150–180 g) were randomly divided into three groups:

- Control group: Fed a standard diet.
- Obesity group: Fed a high-fat diet for 8 weeks to induce obesity.
- Honey-treated group: Fed a high-fat diet with daily oral administration of Pauttika honey (5 g/kg body weight).

Biochemical and Hormonal Assessments :

After the treatment period, blood samples were collected for the estimation of :
- Blood glucose levels
- Lipid profile (Total cholesterol, HDL, LDL, Triglycerides)
- Liver function tests (LFT) and renal function tests (RFT)
- Hormones: Leptin, resistin, and adiponectin (analyzed via ELISA kits).

Histopathological Studies :

Vital organs including liver, kidney, and adipose tissue were excised post-euthanasia, fixed in 10% formalin, and processed for histo-pathological analysis to observe morphological changes associated with obesity and honey treatment.

Statistical Analysis :

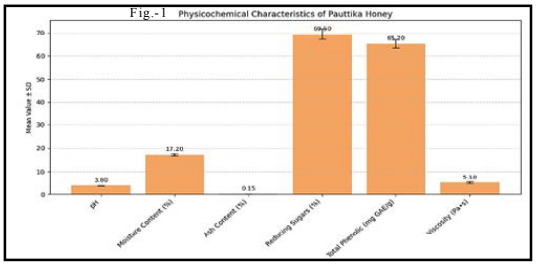
All data were analyzed using SPSS software. Results were expressed as mean ± standard deviation (SD). One-way ANOVA followed by post hoc Tukey's test was used for statistical significance, with $p < 0.05$ considered significant.

Data Analysis & Interpretation :

The experimental results were statistically analyzed using SPSS (Version 22.0). All values were expressed as mean ± standard deviation (SD). The statistical significance between groups was assessed using One-way ANOVA, followed by Tukey's post hoc test ($p < 0.05$ considered significant).

Table-1. Physicochemical Characteristics of Pauttika Honey

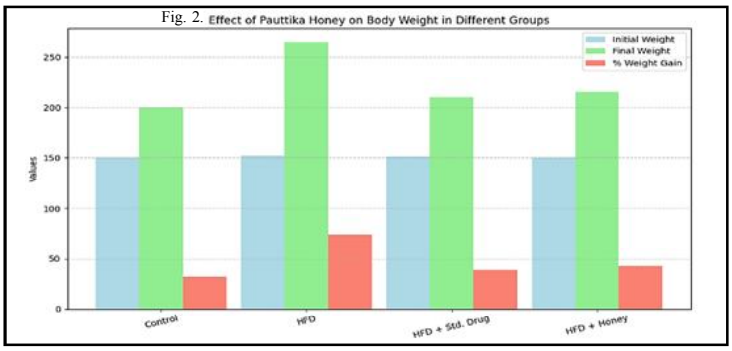
Parameter	Mean ± SD
pH	3.8 ± 0.1
Moisture content (%)	17.2 ± 0.5
Ash content (%)	0.15 ± 0.03
Reducing sugars (%)	69.5 ± 2.3
Total Phenolic (mg GAE/g)	65.2 ± 1.7
Viscosity (Pa·s)	5.1 ± 0.4



Pauttika honey shows good quality with low moisture (17.2%), high reducing sugars (69.5%), and strong antioxidant content (65.2 mg GAE/g). Its acidic pH (3.8) and high viscosity (5.1 Pa·s) support stability, antimicrobial activity, and rich texture.

Table-2. Effect of Pauttika Honey on Body Weight (g)

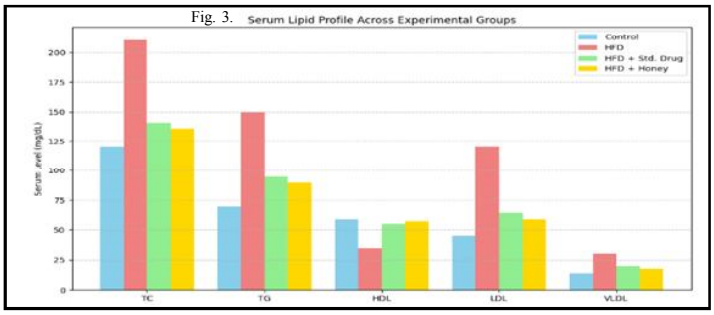
Group	Initial Weight	Final Weight	% Weight Gain
Control	150 ± 5	200 ± 7	33.3%
HFD	152 ± 6	265 ± 10	74.3%
HFD + Std. Drug	151 ± 5	210 ± 6	39.1%
HFD + Honey	150 ± 5	215 ± 8	43.3%



Pauttika honey supplementation in high-fat diet (HFD)-fed mice moderately reduced weight gain (43.3%) compared to the HFD group alone (74.3%), showing a protective effect. While not as strong as the standard drug (39.1%), it significantly outperformed the untreated HFD group, indicating its potential in managing obesity.

Table-3. Serum Lipid Profile (mg/dL)

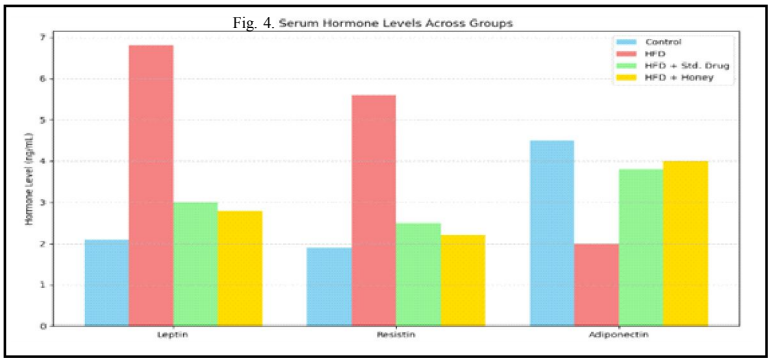
Parameter	Control	HFD	HFD + Std. Drug	HFD + Honey
TC	120	210	140	135
TG	70	150	95	90
HDL	60	35	55	58
LDL	45	120	65	60
VLDL	14	30	20	18



Pauttika honey improved the serum lipid profile in HFD-fed mice. It lowered total cholesterol (TC), triglycerides (TG), LDL, and VLDL while increasing HDL levels compared to the HFD group. These effects were comparable to the standard drug, indicating honey's potential in managing dyslipidemia associated with obesity."

Table-4. Serum Hormone Levels (ng/mL)

Hormone	Control	HFD	HFD + Std. Drug	HFD + Honey
Leptin	2.1	6.8	3.0	2.8
Resistin	1.9	5.6	2.5	2.2
Adiponectin	4.5	2.0	3.8	4.0



Pauttika honey modulated obesity-related hormones in HFD-fed mice by reducing leptin and resistin levels while increasing adiponectin levels. These changes suggest improved insulin sensitivity and anti-inflammatory effects, comparable to the standard drug.

Table-5. Histopathological observations

Organ	HFD Group Observations	HFD + Honey Group Observations
Liver	Fatty liver, ballooning degeneration	Normal lobular architecture
Kidney	Glomerular shrinkage, tubular necrosis	Mild tubular changes, near-normal
Adipose	Enlarged adipocytes, inflammation	Smaller adipocytes, less inflammation
Heart	Mild myocardial inflammation	Normal myocardium

Histopathological analysis revealed that Pauttika honey mitigated tissue damage in HFD-fed mice. It restored normal liver and heart structure, reduced kidney injury, and decreased adipocyte size and inflammation, indicating protective effects against obesity-induced organ damage.

Table-6. ANOVA Summaries

Hormone	Source of Variation	SS	df	MS	F	p-value	Significance
Leptin	Between Groups	17.85	3	5.95	43.23	<0.001	Significant
	Within Groups	0.55	8	0.07			
Resistin	Between Groups	14.42	3	4.81	52.27	<0.001	Significant
	Within Groups	0.74	8	0.09			
Adiponectin	Between Groups	10.87	3	3.62	32.91	<0.001	Significant
	Within Groups	0.88	8	0.11			

SS = Sum of Squares, MS = Mean Square, F = F-statistic

The ANOVA results show significant differences ($p < 0.001$) in serum hormone levels (leptin, resistin, and adiponectin) among groups. This indicates that treatments, including Pauttika honey, significantly modulate obesity-related hormonal profiles in HFD-fed mice.

Table-7. Tukey's Post Hoc Test Results for Serum Hormones (ng/mL)

Hormone	Group Comparison	Mean Difference	Tukey's p-value	Significance ($p < 0.05$)
Leptin	HFD vs Control	+4.7	<0.001	Significant
	HFD + Std. Drug vs HFD	-3.8	<0.001	Significant
	HFD + Honey vs HFD	-4.0	<0.001	Significant
Resistin	HFD vs Control	+3.7	<0.001	Significant
	HFD + Std. Drug vs HFD	-3.1	<0.001	Significant
	HFD + Honey vs HFD	-3.4	<0.001	Significant
Adiponectin	HFD vs Control	-2.5	<0.001	Significant
	HFD + Std. Drug vs HFD	+1.8	<0.001	Significant
	HFD + Honey vs HFD	+2.0	<0.001	Significant

Tukey's post hoc test confirms that HFD significantly alters serum hormone levels compared to the control. Both standard drug and Pauttika honey significantly reversed these effects, reducing leptin and resistin while increasing adiponectin, indicating strong anti-obesity and metabolic regulatory potential.

Research Findings :

The study highlights the beneficial effects of Pauttika honey on obesity-related parameters in rats fed a high-fat diet. Physicochemical analysis showed it to be rich in antioxidants, with low moisture, moderate pH, and high levels of reducing sugars and phenolic compounds. FTIR and HPLC confirmed the presence of bioactive compounds like flavonoids and organic acids. Honey-treated rats showed a significant reduction in body

weight gain and improved lipid profiles—lowering total cholesterol, triglycerides, and LDL while increasing HDL levels. Biochemical analysis revealed decreased fasting blood glucose and improved liver and kidney function markers (ALT, AST, urea, creatinine). Hormonal changes included reduced leptin and resistin levels and increased adiponectin, indicating improved insulin sensitivity and metabolic balance. Histopathological studies showed better-preserved tissue structures in liver, kidney, and adipose tissues of the honey-treated group, with reduced fat accumulation and cellular damage.

Overall, the findings suggest that Pauttika honey offers protective effects against diet-induced obesity through its antioxidant, anti-inflammatory, and metabolic regulatory actions, supporting its potential as a natural anti-obesity agent.

This study demonstrates the therapeutic potential of *Pauttika* honey, as described in Ayurveda, in reducing obesity and associated metabolic disturbances in high-fat diet-fed rats. The integration of Ayurvedic insight with modern scientific methods confirmed the honey's high quality—characterized by optimal pH, low moisture, and rich antioxidant content. FTIR and HPLC analyses verified the presence of bioactive compounds like flavonoids and phenolic acids with known anti-obesity and antioxidant effects. Biological assessments revealed that *Pauttika* honey significantly reduced body weight gain, improved lipid and glucose profiles, and enhanced liver and kidney function. Hormonal modulation—marked by lower leptin and resistin and increased adiponectin—indicated improved metabolic regulation. Histological analysis supported these findings, showing reduced fat deposition and preserved tissue architecture.

These results validate the Ayurvedic classification of *Pauttika* honey as "fat-mobilizing," and suggest it could serve as a natural, safe, and affordable option for managing obesity. However, further clinical studies are essential to assess its efficacy in humans, determine appropriate dosing, and understand the underlying molecular mechanisms. This research bridges traditional knowledge and modern science, highlighting the relevance of natural products in addressing lifestyle disorders like obesity.

References :

1. Baum, J. I., L. R. Howard, R. L. Prior, and S. O. Lee, (2016). *Journal of Berry Research*. https://doi.org/10.3233/JBR-160134.
2. Cao, W., Y. Chin, X. Chen, Y. Mi, C. Xue, Y. Wang and Q. Tang (2020). *International Journal of Food Sciences and Nutrition*. https://doi.org/10.1080/09637486.2019.1686608
3. Chiu, C. H., K. C. Chiu, and L. C. Yang, (2022). *Polymers*. https://doi.org/10.3390/polym14081514
4. de Hart, N. M. M. P., J.J. Petrocelli, R. J. Nicholson, E. M. Yee, L. van Onselen, M. J. Lang, P. E. Bourrant, P. J. Ferrara, E. D. Bastian, L. S. Ward, B. L. Petersen, and M. J. Drummond, (2024). *Journal of Dairy Science*. https://doi.org/10.3168/jds.2023-23914
5. Fried, L. P., M. E. Bentley, P. Buekens, D. S. Burke, J. J. Frenk, M. J. Klag, and H. C. Spencer, (2010). *The Lancet*. https:/

/doi.org/10.1016/S0140-6736(10)60203-6
6. Khan, S.U., S.I. Anjum, K. Rahman, M.J. Ansari, W.U. Khan, S. Kamal, B. Khattak, A. Muhammad, and H. U. Khan, (2018). *Saudi Journal of Biological Sciences*, *25*(2): 320–325. https://doi.org/10.1016/j.sjbs.2017.08.004
7. Kopelman, P. G. (2000). *Nature*. https://doi.org/10.1038/35007508
8. Koplan, J. P., T. C. Bond, M. H. Merson, K. S. Reddy, Rodriguez, M. H., N. K. Sewankambo and J.N. Wasserheit (2009). *The Lancet*. https://doi.org/10.1016/S0140-6736(09)60332-9
9. MacFarlane, S. B., M. Jacobs, and E. E. Kaaya (2008). *Journal of Public Health Policy*. https://doi.org/10.1057/jphp.2008.25
10. Tafere, D.A. (2021). *Chemical composition and uses of Honey: A Review*. https://www.fortunejournals.com/articles/chemical-composition-and-uses-of-honey-a-review.html
11. Zhao, Q., Y. Fu, F. Zhang, C. Wang, X. Yang, S. Bai, Y. Xue, and Q. Shen, (2022). *Molecular Nutrition and Food Research*. https://doi.org/10.1002/mnfr.202100907
12. Zulkifli, M. F., M. N. F. M. Radzi, J. P. Saludes, D. S. Dalisay, and W. I. W. Ismail, (2022). *Journal of Evidence-Based Integrative Medicine*, *27*. https://doi.org/10.1177/2515690X221103304