WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Design and Development of Pedal Operated Cycle Atta Chakki

Deepak Dongre[1], Dipanshu Gajbhiye[2], Akshay Bhoyar[3], Prof. Kalpesh Kanphade[4]

[1-3]B.Tech. Student, Department of Mechanical Engineering, J D College of Engineering and Management, Nagpur
[4]Professor, Department of Mechanical Engineering, J D College of Engineering and Management, Nagpur

ABSTRACT:

The pedal operated cycle atta chakki is an alternative milling device that uses human pedal power rather than electric or fossil fuel energy. It offers potential advantages in sustainability, cost savings, and applicability in off-grid or rural settings. This review examines existing designs, performance metrics, ergonomics, engineering constraints, and gaps in literature for pedal based atta chakki machines. Key parameters such as grain engineering properties, stone clearance, pedal RPM, throughput (kg/h), power transmission mechanisms, material selection, and human comfort are synthesized from recent studies. The review also highlights challenges in scaling, consistency of output, maintenance issues, and human fatigue. Finally, directions for future research are proposed, including hybrid/assisted designs, adaptive ergonomics, material innovations, and standardized evaluation metrics.

Key word – Pedal operated atta chakki , Cycle flour mill , Engineering properties of grains , Throughput & capacity , Ergonomics & human effort , Sustainability & off-grid milling , Stone clearance & grinding mechanism etc.

INTRODUCTION:

Flour (atta) is a staple in many South Asian diets, especially in India and nearby regions. Traditional milling often uses electricity or motorized mills, but in many rural or remote areas electricity is unavailable, unreliable, or expensive. Thus there is motivation to design milling machines that use human power— specifically pedal or cycle-driven systems. Pedal operated cycle atta chakkis (flour mills) promise lower operational cost, independence from grid power, environmental sustainability, and empowerment of users in low-resource settings.

However, human-powered milling comes with trade-offs: decreased throughput, possible human fatigue, demands on mechanical design such as achieving sufficient torque and speed, durability, and consistency of the flour produced. Over the past decade, several studies have tried to address these trade-offs by optimizing design elements: drive transmission, stone type and clearance, frame and ergonomics, selecting materials, and characterizing the engineering properties of grains.

This review consolidates the findings of these studies, identifies what has been done, where the limitations are, and suggests future research directions to make pedal operated atta chakkis more effective, usable, and adopted.

LITERATURE SURVEY:

Yallappa et al. (2024), Design of Pedal Powered Atta Chakki Based on Engineering Properties of Selected Food Grains Studied engineering properties of several grains (rice, pigeon pea, wheat, sorghum, maize): size, shape, aspect ratio, geometric mean diameter, sphericity, bulk & true density, porosity, weight of 1000 grains, hardness, angle of repose etc. Used this data to design various components (hopper, drive, grinding stones etc.). Developed a pedal operated mill suitable for grinding cereals and pulses into atta, rawa, dhal etc. Design considerations informed by grain properties leading to more appropriate stone clearance, drive selection etc. Though engineering data is rich, performance results (throughput, durability under field conditions) are limited; user comfort/long-term operation less addressed.

Yallappa et al. (2019), Performance evaluation of pedal operated flour mill with multi-applications Tested the pedal mill with different types of grains. Varied stone clearance to produce fine flour, rawa, dehusk etc. Measured yield, throughput, cost, and other parameters. Found fine flour capacity ~2-3 kg/h; dehusking of pigeon pea ~8.5-10 kg/h; operating cost low; high yield recovery depending on clearance and pedal speed (70 rpm for certain cases). Throughput is modest; continuous operation may cause fatigue; quality of flour (in terms of particle size distribution, moisture etc.) less thoroughly studied.

Design and Working of Pedal Operated Flour Mill (IJTSRD, 2019)Conceptual design, selection of transmission, stone pair selection, frame, use of bicycle/crank mechanism to drive the stones.Presents a prototype and explains mechanics of motion transmission; shows benefits over manual grinding:

increased throughput and somewhat lower human effort. Less quantitative data; e.g., on human power input, ergonomic assessment, comparison with motorized mills under same conditions.

JARIIE (2025), "Design and Development of Pedal Operated Atta Chakki Machine" The methodology involved conceptual

design, component selection (frame, flywheel, grinding stone), fabrication, testing & optimization, performance measurement: output rate, consistency, human comfort etc. Reported improvements over very rudimentary designs; better user comfort, smoother operation, modular/flywheel based systems that reduce pedaling difficulty; cost effectiveness vs electric mills. Details on long-term durability, maintenance frequency, detailed ergonomic metrics (heart rate, fatigue) are limited; pilot scale, not widely field tested.

Ergonomic Evaluation of Conventional Rural Flour Mills (2025), EPJ Web Conf. Evaluated ergonomic challenges in operators of traditional rural flour mills (which may or may not be pedal powered) via methods like REBA (Rapid Entire Body Assessment). Identified postures, repetitive motions, standing duration etc.Shows high ergonomic risk from conventional mills; informs design improvements (position, height, posture etc.) that would also apply to pedal powered mills. Not specific to pedal cycle flour mills; less about mechanical design; more on human operator strain.

Other related work There are other studies in milling, small-scale food mills, grain pre-processing etc. For example, work on hybrid grinding techniques to improve quality of stone chakki atta.These works contribute understanding of flour quality, effect of grinding type, energy consumption etc.May use motorized or roller mills rather than purely human powered systems.

DESIGN CONSIDERATION SYNTHESIZED :

From the literature, certain design requirements and trade-offs

emerge. Key parameters are:

Grain Engineering Properties: Density, hardness, size, shape, bulk density etc. These inform hopper shape, feeding mechanism, grinding stone selection, torque needed.

Stone Clearance: The gap between grinding stones is critical. Examples: ~3 mm for fine flour, 5 mm for rawa, ~7 mm for dhal/ dehusk. The yield, throughput, and quality depend heavily on this clearance.

Pedal / Crank Speed (RPM) and Human Power Input: To obtain sufficient stone speed and torque to grind effectively. For example, 70 rpm was used in some tests. Higher rpm improves throughput but increases human effort.

Transmission & Flywheel: Chain, sprocket, belt, or direct drive from pedals to grinding unit; inclusion of flywheel helps smooth pedal strokes, reducing peaks of effort. Material selection in drive (bearings etc.) important for efficiency.

Frame & Structural Design: Must be robust, stable, made of suitable material (steel, mild steel) to resist deformation, provide alignment of stones, support load. Also ensure safety, guarding of moving parts.

Ergonomics: Operator posture (seat, pedal height), pedal reach, comfort; minimizing fatigue; also adjustability. Some studies do ergonomic evaluation of existing mills, which reveals high risk posture that pedal powered design should try to avoid.

Capacity / Throughput: Trade-off between capacity and human effort. In many prototypes, fine flour throughput is only ~2-3 kg/h; dehusking or coarse output higher. Use case (household vs community vs commercial) will dictate needed capacity.

Cost & Materials: Use of locally available materials, cost of fabrication, maintenance cost. Lower cost makes adoption easier.

Quality of Flour: Particle size distribution, moisture content, presence of bran, nutritional factors. Grinding stone type (stone vs metal), clearance, consistency matter.

Durability & Maintenance: Wear of stones, alignment, lubrication of moving parts etc. Maintenance regimes need to be minimal and parts accessible.

CONCLUSION:

Pedal operated cycle atta chakkis represent a promising sustainable technology for low-resource and off-grid settings. The existing body of work has largely succeeded in establishing the foundational design parameters: understanding grain properties, choosing grinding stone clearance, designing drive systems and optimizing for throughput vs human effort. Prototypes and small scale machines have demonstrated capacities for fine flour, rawa, dehusking etc., with modest throughputs (typically 2-10 kg/h depending on product).

However, several challenges remain:

Throughput is low for large households or community use; scaling without excessive human effort is difficult.

Long-term durability and maintenance under field conditions need more study.

Consistency of flour quality (particle size distribution, moisture, nutritional retention) needs more quantitative measurement.

Ergonomic aspects (fatigue, posture, physiological cost) are under-studied.

Adoption barriers: user acceptability, cost, materials supply, cultural preferences.

For future development, combining pedal power with assistive power (e.g. solar, small motor), adjustable and modular designs

(for different grain types, output fineness), better ergonomics, lightweight materials, and developing standard performance benchmarks will help. Also, field trials and user studies are necessary to assess real-world effectiveness

REFERENCES:

Below are key references that can be used (authors, journal, volume, pages)

Yallappa, D.; P. F. Mathad; Ambrish G; Udaykumar Nidoni; Roopa Bai; Kavan Kumar V; Ravi Y. Design of Pedal Powered Atta Chakki Based on Engineering Properties of Selected Food Grains. Archives of Current Research International, Vol. 24, Issue 4, 2024.

Yallappa, D.; P. F. Mathad; Uday Kumar Nidoni; T. Gururaj; R.

S. Roopabai; S. G. Ambrish; C. Kenchappa. Performance Evaluation of Pedal Operated Flour Mill with Multi-Applications. Journal of Pharmacognosy and Phytochemistry, Vol. 8(2), 2019.

Dr. Kishorkumar Guru; Saurabh Pratap Singh; Saurabh Tiwari; Saurabh Pal; Saurabh Kumar Shukla. Design and Working of Pedal Operated Flour Mill. International Journal of Trend in Scientific Research and Development (IJTSRD), 2019.

Design and Development of Pedal Operated Atta Chakki Machine. IJARIIE, Vol. 11, Issue 2, 2025.

Gawande, K.; Somdatta Tondre; Niraj Raja; Rajesh Pokale. Ergonomic Evaluation of Conventional Rural Flour Mills in India: Challenges and Recommendations. EPJ Web of Conferences, Vol. 328, Article 01058, 2025.

Arora, Mohit; Ashwin Kumar; Suresh D. Sakhare; Aashitosh A. Inamdar. Application and effect of hybrid grinding techniques on the quality of stone chakki atta (whole wheat flour) and flat bread. Journal of Food Science and Technology, 2022.

Design and Fabrication of Pedal Operated Wet Pulses Grinding Machine , Dr. A.V. Vanalkar, Aniket Armarkar, Aditya Ojha, Akash Pol, Sanket Kalode, Sameer Nagdeve, Aditya Kahalkar. IJRASET, 2022,. A device for grinding wet pulses using pedal power. Useful for understanding moisture effects, design for wet grinding, human effort vs output in pulses.

Design and Modelling of Pedal Powered Flour Mill , Pratik Naladkar, Manishant Kakade, Ramireddy Prashant Kumar Reddy. IRJET, Vol. 8, Issue 11, Nov 2021. Focused on modeling the drive, gears, shaft, CAD/Static structural design—good for mechanical / transmission design portions.

Performance Evaluation of Pedal Operated Flour Mill with Multi-Applications Yallappa D. et al., 2019. Already known but very relevant: gives performance yields, throughput, details of stone clearance etc. Helpful for quantitative comparison.

Design of Flour Mill Based on Engineering Properties of Green Gram Using SOLIDWORKS , Rangineni Manasa Lakshmi Durga & Shanmukha Rangeneni. Advances in Research, 2025. Provides engineering property data (sphericity, density, friction, angle of repose etc.) for green gram. Helpful for design of parts (hopper, feed, stone stones) specific to pulses.

Studies of a Rotary–Centrifugal Grain Grinder Using a Multifactorial Experimental Design MethodAndrzej Marczuk, Agata Blicharz-Kania, Petr A. Savinykh, et al., Sustainability, 2019. Not pedal powered, but useful for grinding mechanism design; provides experimental design of parameters affecting grinder performance which might be adaptable.

Performance Analysis of Pedal Powered Multipurpose MachineS.G. Bahaley, Dr. A.U. Awate, S.V. Saharkar, IJERT, 2012. Multipurpose pedal-powered machine; gives insights in performance under different loads, useful for understanding power limits of human-drive and structure.