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TECHNOLOGICAL INNOVATIONS IN SIDDHA DRUG MANUFACTURING: AN OBSERVATIONAL STUDY OF ASU PHARMACEUTICAL INDUSTRIES ACROSS TAMILNADU, INDIA

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ABSTRACT

This observational study investigates the technological innovations and infrastructural developments in Siddha pharmaceutical industries across Tamil Nadu. The research provides a detailed analysis of automated machinery, modern fermenting vessels, packaging improvements, preservatives, and quality control measures aligned with AYUSH and international standards. The study also documents research and development efforts focused on new proprietary formulations and standardization, showcasing the industry's shift from traditional to large-scale production. Key infrastructural features such as segregated production areas and centralized packing sections are analyzed alongside the impact of mechanization affects efficiency and product consistency. While technological integration has enhanced mass production and regulatory compliance, challenges remain, including raw material scarcity, cost fluctuations, limited clinical validation, and slow modernization in smaller units. The study offers valuable insights into the current state of Siddha pharma industries, emphasizing the need for balanced modernization, improved quality assurance, and strategic marketing to promote sustainable growth and global acceptance.

Keywords: Siddha pharmaceuticals, AYUSH labs, automated machinery, quality assurance, traditional medicine.

INTRODUCTION

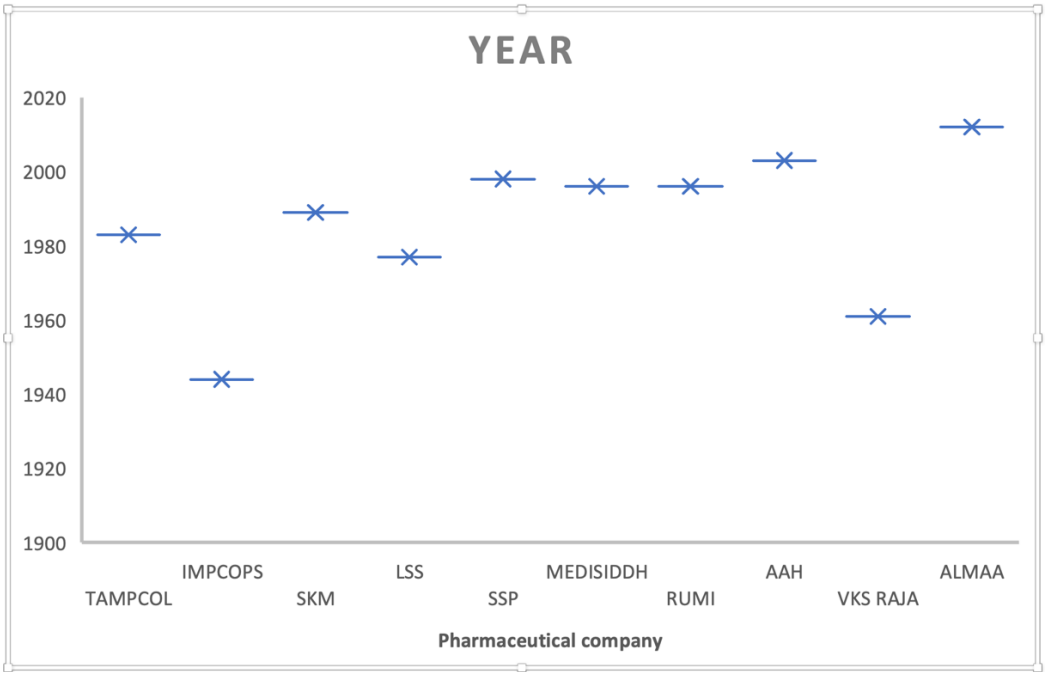
Siddha medicine has a distinct branch of pharmaceutics dedicated to drug manufacturing, standardization, and quality control [1]. A regulatory framework has been established under the Drugs and Cosmetics Act (1940) [2], along with the development of a pharmacopeia and formularies. In Siddha practice, a wide range of therapeutic substances are traditionally employed, including herbals, processed metals and minerals, purified poisonous drugs, animal-origin materials, marine-based drugs, and several other natural products [3]. Medicines (Marundhu) in Siddha are broadly classified into thirty-two internal medicines (Aga marundhu) and thirty-two external medicines (Pura marundhu), which in modern pharmaceutical terms correspond to various "dosage forms." Common dosage forms, such as pills (kuligai), powders (churanam), decoctions (kudineer), and medicated oils (thailam), continue to be widely used due to their simplicity and effectiveness [2]. However, more complex formulations, including parpam, chendooram, kattu, kalangu, chunnam, karpam, and guru kuligai, involve elaborate preparation methods requiring specialized apparatus, diverse heating techniques, and strict adherence to specific heating schedules [4]. Traditional preparation methods allow only the production of limited quantities of medicine and demand significant manual labour to ensure quality and efficacy. With the growing global acceptance of traditional medical systems, particularly Siddha, the need for large-scale production has driven the process of industrialization. At the same time, the pharmaceutical industry faces multiple challenges, including the rise of emerging diseases, the integration of innovative technologies, and the necessity for agile R & D and manufacturing models. These factors compel pharmaceutical companies to enhance innovation capacity, reduce manufacturing costs, improve productivity, and shorten time-to-market. This study highlights recent advancements in pharmaceutical process technologies, research and development, the current market trends, existing challenges and limitations, and future possibilities in Ayurveda, Siddha, and Unani (ASU) pharmaceuticals [4,5].

MATERIALS AND METHODS

Study Design: Observational, industrial visit-based study.
Location: Tamil Nadu, India.
Duration: 6 months (Data collection: Sep 2023–Jan 2024).
Sample: 10 Siddha pharmaceutical companies.
Tools: Structured questionnaires, on-site observations.
Analysis: Narrative and thematic analysis using qualitative summaries, graphs, and geographical maps.
Inclusion Areas: Infrastructure, machinery, raw drug procurement, packaging, storage, preservation, patents, certification, quality control.

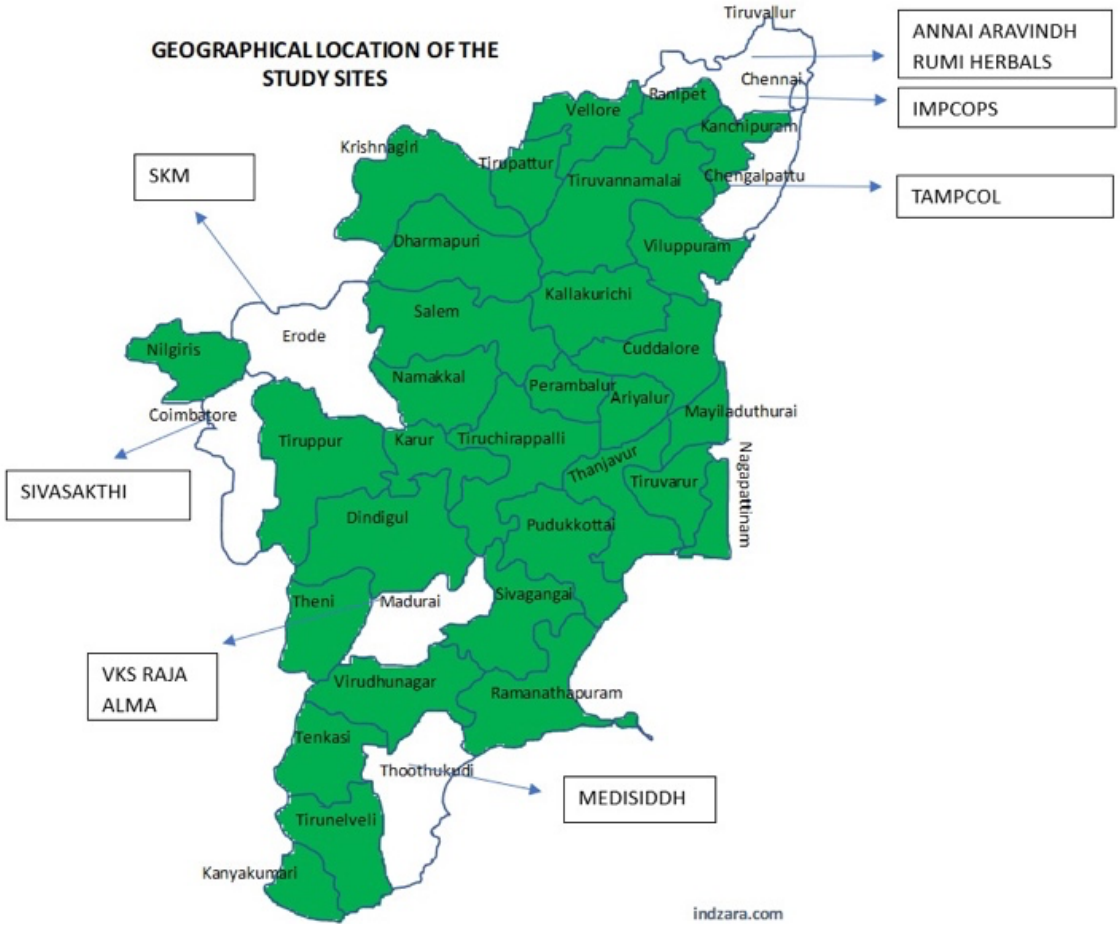
List of pharmaceutical companies
1.Tampcol, Sidco, Alathur, Chengalpattu
2.IMPCOPS, Thiruvanmiyur, Chennai
3. Rumi Herbals Pvt Ltd, Ambatur Industrial Estate, Tiruvallur
4. Annai Aravindh Herbals Pvt Ltd, Maduravoyal, Tiruvallur
5. SKM Siddha and Ayurveda Pvt Ltd, Erode
6. Sivasakthi Pharmaceuticals Pvt Ltd, Coimbatore
7.Lakshmi Seva Sangam, Dindigul
8. Almaa Herbals Pvt Ltd, Thirumangalam, Madurai

9. Medisiddh Pharmaceuticals, Kovilpatti, Tuticorin
10.VKS Raja Siddha Marundhagam, Madurai [6]



Graph 1: Year of establishment of Siddha pharmaceutical industry

Infrastructure



Picture 1: Geographical Locations of study site

OBSERVATION AND RESULTS

Total land area

The land area occupied by Siddha Pharmaceutical Industries shows considerable variation, ranging from approximately 7,000 square feet in smaller establishments to nearly 14 acres in large-scale units, depending on the scale of operations and geographic location. In urban regions, industries are usually concentrated within designated industrial estates, such as the Ambattur Industrial Estate and SIDCO Industrial Area, where access to infrastructure, utilities, and regulatory oversight is more streamlined. Conversely, larger units are often established in rural areas where expansive land is more readily available and cost-effective, allowing the development of bulk production facilities, extensive storage systems, research wings, and allied infrastructure. The variation in land utilization not only reflects the organizational diversity within the Siddha pharmaceutical sector but also significantly influences production capacity and scalability. Smaller urban units are better suited for specialized formulations and faster distribution, while larger rural units facilitate mass production, long-term storage, and industrial expansion. Thus, the availability and extent of land serve as a critical determinant in shaping the operational efficiency, output volume, and future growth potential of Siddha pharmaceutical industries [7].

Table 1: Comparison of Urban and Rural Siddha Pharmaceutical Industries

Parameter	Urban Industries	Rural Industries
Land Area	Limited space (approx. 7,000 sq. ft. to a few acres).	Larger land availability (up to 14 acres or more).
Location	Primarily in industrial estates (e.g., Ambattur Industrial Estate, SIDCO).	Located in villages or rural outskirts with abundant land
Infrastructure	Well-developed infrastructure, access to utilities, and regulatory oversight.	Infrastructure may be less developed; additional investment required for facilities
Production Scale	Small to medium-scale; suitable for specialized formulations and fast distribution.	Large-scale manufacturing; suitable for bulk production and long-term storage
Scalability	Limited scalability due to space restrictions	High scalability with potential for industrial growth and expansion.
Advantages	Better connectivity, a skilled workforce, and proximity to regulatory offices.	Cost-effective land, greater space for storage, research, and mass manufacturing.
Limitations	High operational costs, space limitations, and dependency on rented infrastructure.	Challenges with connectivity, logistics, skilled labour availability, and power supply.

Workflow and Room Segregation in Siddha Pharmaceutical Industries

Raw Material Handling

a. Raw Drug Storage Room → Initial storage of herbs, minerals, animal-origin materials, and other raw drugs.
b. Container Storage Room → Separate storage for packaging containers to prevent contamination.

Primary Processing Units

a. Chooranam Room → Grinding and pulverizing of raw materials into powders.
b. Kalvam Section → Wet grinding of raw materials using traditional grinders.
c. Disintegrator Section → Mechanical disintegration and particle size reduction.

Dosage Form–Specific Sections

a. Capsule Section → Encapsulation of powdered medicines.
b. Tablet Section → Compression of powders into tablets.
c. Kashayam/Oil/Syrup Section → Preparation of herbal decoctions, medicated oils, and syrups.
d. Special Formulation Sections → Rooms for traditional formulations like Arishtam, Kuzhi Thylam, Mayana Thylam, and Pudam (calcination process).

Intermediate and Specialized Facilities

a. Boiler Plant → Provides steam and heat energy for decoctions, oil processing, and sterilization.
b. Drying Yard/Solar Dryer → Controlled drying of herbal materials and semi-finished products.

Quality Control and Segregation

a. Finished Goods Section → Storage of approved and quality-checked medicines.
b. Rejected Goods Section → Isolated storage of products failing to meet quality standards.

Packaging and Labelling

a. Packing Areas → Separate spaces for *Chooranam*, syrups, oils, *Kashayam*, *Arishtam*, shampoos, creams, soaps, and sachets.
b. Labelling Room → Manual labelling of packaged medicines.
c. Laser Label Printing Room → Automated labelling with batch codes, expiry, and product details.
d. Centralized Packing Section → Final packaging, sealing, and preparation for distribution.

Machinery in Siddha Pharmaceutical Industries

Machinery plays a vital role in the large-scale production of Siddha pharmaceutical products. With increasing demand, manual methods of drug processing have been progressively replaced by automatic and semi-automatic technologies. Modernized equipment is now employed in every stage of production; raw drug processing, formulation, packaging, labelling, and waste management [8,9]. These innovations improve efficiency, minimize human error, ensure hygiene, and maintain compliance with AYUSH guidelines.

Raw Drug Processing Machinery

Specialized machines are used in the initial handling and processing of raw materials:

- *Kadukkai* Separator Machine – for separating *Terminalia chebula* seeds/fruit.
- Disintegrator – for particle size reduction of raw herbs and minerals.
- Roaster – for controlled roasting of raw drugs as per traditional requirements.
- Lime Cutting and Squeezing Machine – for processing lime used in Siddha formulations.

Picture 2: Manufacturing unit and machineries

Medicine Preparation Machinery

a) Chooranam (Powders)-Pulveriser machines (impact, mini, and micro types), automatic pounding machines, shredders, end runner mills, double/triple roller mills, blenders, sifters with varied mesh sizes, and tray dryers are used for grinding, mixing, blending, and drying the powders.
b) Parpam / Chendooram (Calcined Preparations)-Mechanized Kalvam (granite grinding apparatus) and wet grinders enable fine and uniform grinding, replacing the traditional manual grinding stones.
c) Legiyum / Syrup Preparations-Equipment such as Legiyum making pans, syrup preparation pans, blenders, and juicers are used for the preparation of semi-solid and liquid formulations.
d) Tablets and Capsules- Tablet punching machines, coating machines, capsule-filling machines, dryers, thread-making machines (for pills), and ball mills with jars are used to achieve standardized dosage forms with consistent quality.

Packaging and labelling Machinery

Sophisticated packaging units ensure safety, hygiene, and market compliance for various formulations:

- Chooranam filling machines (automatic and semi-automatic)
- Tablet and capsule counting machines
- Blister packaging machines
- Filling machines for syrups, oils, Kashayam, Arishtam, shampoos, and creams
- Sachet-making machines
- Shrink wrappers and bag sealers
- Aluminium foil sealing machines
- Slot counters
- Dip tea bag–making machines
- Inkjet printing machines and laser label printers
- Automatic induction wad sealing machines and cap sealing machines

Waste Management Machinery

Waste generated during production is processed using machines like:

- Screw Press – for separating liquid from solid residues.
- Hydraulic Press – for compacting pharmaceutical waste before safe disposal.

This systematic integration of machinery across all stages of Siddha medicine production has enhanced the scalability of the industry, ensuring mass production without compromising on traditional authenticity. By balancing mechanization with Siddha principles, industries are able to guarantee both efficiency and pharmaceutical quality standards.

Raw Drug Management in Siddha Pharmaceutical Industries

The procurement of raw drugs in Siddha pharmaceutical industries is primarily carried out through quotations or tender-based systems to ensure standardized sourcing and transparency. Once procured, the quality of raw drugs is evaluated through rigorous testing in pharmacognosy and chemistry laboratories to confirm identity, purity, and potency. Following quality certification, the raw drugs undergo purification procedures in accordance with Siddha texts and AYUSH guidelines to eliminate impurities and enhance therapeutic efficacy. Finally, the processed raw materials are securely stored in designated facilities, with appropriate conditions such as hot storage or cold storage, depending on the specific requirements of the drug. This systematic approach ensures that only quality-assured raw drugs are utilized in the pharmaceutical industries [7].

Table 2: Raw Drug Management in Siddha Pharmaceutical Industries

Process	Purpose
Procurement	Raw drugs are procured through quotations or tender-based systems to ensure reliable sourcing and transparency.
Quality Testing	Collected samples are tested in pharmacognosy labs for identity and botanical authentication. Chemical analysis (purity, adulteration, heavy metals, etc.) is carried out in dedicated chemistry laboratories.
Purification (Suddhi)	Raw materials undergo purification processes (suddhi*)* as prescribed in Siddha classical texts and AYUSH guidelines (e.g., washing, roasting, soaking, grinding with herbal juices). This step removes impurities, toxins, or microbial contaminants and enhances therapeutic efficacy.
Storage	Purified and approved drugs are stored under controlled conditions: Hot Storage for substances requiring dry, warm environments

Medicine Preparation and Reference Sources

The preparation of medicines in Siddha pharmaceutical industries is carried out in accordance with authoritative reference texts to ensure standardization and authenticity. The primary references include the Siddha Pharmacopoeia of India, the Siddha Formulary of India, and various traditional Sastric texts [10] that provide detailed guidelines on formulations, dosage forms, and processing methods. In cases where specific raw drugs are unavailable, substitutions or alterations are selected based on the classical reference text Bavaprakasham, thereby maintaining therapeutic efficacy while adhering to traditional principles.

Preservation of Siddha Medicines

The preservation of Siddha medicines is carried out in accordance with the standards prescribed by AYUSH guidelines to ensure stability, safety, and prolonged shelf life. Appropriate preservatives are incorporated during formulation depending on the dosage form and its storage requirements. Commonly employed preservatives include sodium benzoate (food grade) as an antimicrobial agent, gum acacia as a stabilizer and binder, liquid paraffin for moisture protection, and purified talc for reducing hygroscopicity. Additionally, methyl propionate, methyl paraben, propyl paraben, magnesium stearate, and ascorbic acid are utilized either individually or in combination to provide antioxidant, antimicrobial, and stabilizing effects. The judicious use of these preservatives not only enhances the product's shelf stability but also maintains its therapeutic integrity and compliance with regulatory standards [11].

Storage, Packaging, Naming, and labelling

In Siddha pharmaceutical industries, the storage and packaging of materials are systematically carried out in compliance with AYUSH and WHO guidelines to ensure quality, stability, and safety of medicines.

Storage of Raw Drugs

Raw drugs are typically stored in containers designed to prevent contamination and preserve potency. Common storage materials include stainless steel vessels for bulk and stable drugs, sack bags for dry herbal materials, HDPE (High-Density Poly Ethylene) air-tight containers for volatile or moisture-sensitive substances, and glass or porcelain jars for specific mineral drugs requiring inert and non-reactive storage conditions [12].

Packaging of Finished Products

Finished pharmaceutical products are packed using suitable containers depending on dosage form and stability requirements. These include PET and HDPE containers for powders, syrups, and oils; ointment tubes for semisolid formulations; tea bags and sachets for single-dose powders or decoctions; blister packs for tablets and capsules; droppers and soft gel capsules for liquid and oil-based formulations; along with silica gel packs to control moisture. Advanced techniques such as foil labelling, shrink wrapping, and induction sealing are also employed to ensure tamper-proof packaging and extended shelf life [12].

Naming and labelling

Each product is labelled in accordance with AYUSH regulations, carrying essential information such as the classical or proprietary name, dosage form, batch number, manufacturing and expiry dates, storage conditions, composition, and manufacturer's details. Laser printing and inkjet technology are often used to ensure precision, legibility, and authenticity. Proper naming ensures alignment with classical references, while labelling guarantees transparency, safety, and regulatory compliance, thereby enhancing consumer trust.

Licensing and Certification in Siddha Pharmaceutical Industries

Table 3: Licensing and Certification in Siddha Pharmaceutical Industries

Certification	Purpose	Benefits
GMP (Good Manufacturing Practices)	To ensure medicines are consistently produced and controlled in accordance with quality standards. Covers hygiene, facility design, equipment, documentation, and quality control.	Guarantees product safety and quality. Enhances reliability and consumer trust. Mandatory for both domestic and export markets.
ISO (International Organization for Standardization)	Provides globally recognized standards for quality management systems in manufacturing.	Improves operational efficiency. Enhances global market acceptance. Facilitates international collaborations
FSSAI (Food Safety and Standards Authority of India)	Regulates products classified as food, nutraceuticals, or supplements.	Ensures food-grade quality and safety. Provides market legitimacy for consumable drugs/formulations. Builds consumer confidence.
FSS / State Food Safety Certifications	Additional certifications for state- or region-specific food and health product regulations.	Strengthens compliance with regional standards. Allows wider legal distribution of Siddha formulations.

Licensing and certification serve as critical pillars in ensuring the credibility, safety, and global acceptance of Siddha pharmaceutical products. Compliance with GMP guarantees consistency and quality, ISO certification enhances international recognition, while FSSAI and related food safety certifications ensure adherence to nutritional and safety standards for consumable formulations. Together, these certifications not only strengthen consumer confidence and safeguard health but also support the export readiness and global market competitiveness of Siddha pharmaceuticals, thereby bridging traditional systems of medicine with modern regulatory frameworks [11, 13].

Research and Development

Research and development (R&D) play a pivotal role in advancing Siddha pharmaceutical industries by integrating traditional wisdom with modern scientific approaches. Most industries maintain a dedicated team of professionally skilled and experienced personnel, supported by well-equipped laboratories designed to focus both on developing new products and improving existing formulations. The primary objectives include the introduction of innovative technologies aimed at enhancing

the efficacy, bioavailability, and potency of herbal formulations while ensuring their safety and therapeutic reliability.

A major research focus is on the development of Siddha-based products for the management of highly prevalent chronic diseases such as diabetes, arthritis, hypertension, and lifestyle-related disorders, where long-term safe alternatives are in great demand. Rigorous toxicity and preclinical studies are conducted to evaluate safety profiles, while stability testing of developed products is undertaken in alignment with International Council for Harmonisation (ICH) guidelines to ensure quality and shelf-life. Through these R&D initiatives, Siddha pharmaceuticals aim not only to preserve traditional formulations but also to adapt them for modern clinical relevance, regulatory compliance, and global acceptance.

Quality Assurance (QA)

Quality assurance in Siddha pharmaceutical industries encompasses every stage of production—from raw material procurement to the final packaged product. The process involves continuous monitoring and documentation to ensure that products conform to safety and regulatory standards. Key activities include testing and monitoring the quality of both primary and secondary packaging materials, verifying label content to meet statutory norms, and updating label details as per the Drugs and Cosmetics Act of India, 1945. Quality assurance also involves frequent inspection of raw materials in storage to assess their stability and suitability, thereby preventing deterioration prior to use.

Thorough record-keeping such as Batch Manufacturing Records (BMR) is maintained to trace input, output, handling personnel, and organoleptic characteristics at each step of production. The overall purpose of quality assurance is to implement a preventive approach, ensuring compliance with regulatory standards and minimizing the chances of final product rejection [13,2] .

Quality Control (QC)

In parallel, Siddha pharmaceutical industries maintain well-established in-house quality control laboratories that serve as a cornerstone of product safety, efficacy, and authenticity. These laboratories are typically divided into specialized units for chemistry, pharmacognosy, and microbiology. Comprehensive testing is carried out on raw materials, intermediate products, finished formulations, and packaging materials to verify identity, purity, stability, and microbial safety.

The quality control team includes chemists, botanists, microbiologists, and trained technical staff, each contributing specific expertise in drug testing and validation. Testing procedures and parameters are standardized based on AYUSH publications, SOPs, and protocols laid down by the Ministry of AYUSH, Government of India, covering Siddha, Ayurveda, and Unani medicines. Industries increasingly rely on sophisticated ERP (Enterprise Resource Planning) systems to maintain and retrieve digital records of quality standards, ensuring traceability, consistency, and alignment with national and international regulatory norms [2, 13].

Challenges and Limitations in Siddha Pharmaceutical Industry

The Siddha pharmaceutical industry, while steadily expanding, continues to face several significant challenges and limitations in its growth and standardization. A primary concern is the availability and cost fluctuation of raw drugs and spices, including key materials such as *Elettaria cardamomum* (cardamom) and *Phyllanthus emblica* (amla), which directly affect manufacturing stability. Issues such as seasonal scarcity, adulteration, and inconsistent quality further complicate raw material procurement.

Another critical challenge lies in research and development (R&D), where limitations in funding, infrastructure, and large-scale clinical validation restrict the global recognition of Siddha medicines. Modernization of industries, though underway with mechanization and automation, is uneven, with many small-scale units still reliant on traditional manual methods. In addition, gaps in knowledge dissemination, technical expertise, and skilled workforce development delay the adoption of advanced technologies.

Marketing and distribution remain constrained, as Siddha medicines struggle to compete with allopathic pharmaceuticals and globally established herbal products, pointing towards the need for stronger branding, consumer awareness, and regulatory harmonization. Finally, ensuring standardization, quality assurance, and regulatory compliance poses additional limitations, particularly due to variability in raw drugs and interpretational differences across classical texts.

Challenges related to raw drug procurement, rising costs, modernization gaps, limited R&D, quality standardization, and marketing barriers collectively restrict the industry's growth potential. Addressing these issues through policy support, interdisciplinary research, and technological innovation is essential for strengthening Siddha pharmaceuticals and ensuring their global relevance [14].

DISCUSSION

This study systematically documented the industrial-level technological innovations adopted by Siddha pharmaceutical industries, highlighting advancements in machinery, infrastructure, research, and standardization while also addressing persistent challenges. Industrial-scale units have incorporated automated and semi-automated technologies, including stainless steel Mayana Thailam Karuvi, modernized fermenting vessels for Arishtam, stability chambers, solar/electric/steam dryers, and advanced packing systems such as shrink wrappers, sachet machines, and inkjet printers, which have collectively enhanced production efficiency, reduced manual errors, and improved portability and hygiene of medicines. Despite these benefits, limitations exist, as certain formulations like Mezhugu (e.g., Rasa Gandhi Mezhugu) remain unsuitable for mechanized processing, while traditional methods often face issues such as weight variation in tablets and labour-intensive preparation. The increasing use of preservatives such as sodium benzoate, parabens, and ascorbic acid, along with adherence to AYUSH guidelines and ERP-based documentation, has strengthened quality control and shelf-life consistency, though standardization of complex formulations remains a challenge.

Industrial expansion has been supported by structured infrastructure, including raw drug storage facilities, dedicated ASU preparation sections, cosmetics production units, centralized packing, and stability testing labs, reflecting a transition from small-scale to organized, regulatory-compliant operations.

Research and development initiatives have further advanced proprietary drug development, scientific validation, and standardization, with divisions for pharmacognosy, chemistry, and microbiology supporting toxicity, preclinical, and stability

studies in alignment with ICH and AYUSH guidelines. Nonetheless, significant barriers persist, including fluctuations in the availability and cost of raw materials (e.g., *Elettaria cardamomum*, *Phyllanthus emblica*), inadequate investment in R&D, lack of raw material standardization, limited marketing and global branding strategies, and insufficient professional workforce development, which restrict competitiveness with allopathic and globally recognized herbal sectors. Overall, while technological modernization has improved productivity, packaging, and quality assurance, excessive mechanization risks compromising traditional authenticity. Sustainable growth of the Siddha pharmaceutical industry requires a balanced integration of traditional principles with modern science through coordinated government support, interdisciplinary collaboration, advanced tools such as phytochemical profiling and AI-driven drug discovery, and internationally recognized certification systems, thereby enabling wider global acceptance and integration of Siddha medicine into modern healthcare markets [14, 15].

CONCLUSION

This study comprehensively documented the structural, technological, and regulatory landscape of industrial-level Siddha pharmaceutical industries. From raw drug procurement and purification to medicine preparation, machinery integration, quality assurance, packaging, labelling, and certification, each step reflects the gradual modernization of a traditional system while striving to retain authenticity. The adoption of automated and semi-automated machinery, preservatives, innovative packaging methods, and R&D-driven proprietary medicines highlights the sector's move toward scalability, efficiency, and global competitiveness. At the same time, the establishment of in-house quality control laboratories and adherence to AYUSH guidelines ensures compliance, safety, and standardization [16]. However, challenges such as raw drug availability, cost fluctuations, inadequate clinical validation, limited standardization, weak marketing, and gaps in modernization continue to constrain growth.

Overall, Siddha pharmaceutical industries stand at a crucial transitional phase, where the integration of modern science, research-based innovations, and regulatory frameworks is essential to overcome existing limitations. Strengthening supply chains, investing in advanced R&D, promoting global certifications, and balancing automation with traditional practices will pave the way for the sustainable growth, internationalization, and wider public health impact of Siddha medicine.

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List of Abbreviation

ASU - Ayurveda, Siddha, Unani
AYUSH - Ayurveda, Yoga & Naturopathy, Unani, Siddha, Homoeopathy
BMR - Batch Manufacturing Record
ERP - Enterprise Resource Planning
FSS -Food Safety Standards
FSSAI - Food Safety and Standards Authority of India
GMP - Good Manufacturing Practice
HDPE - High-Density Polyethylene
ICH - International Council for Harmonisation
ISO - International Organization for Standardization
PET - Polyethylene Terephthalate
R&D - Research and Development
SIDCO - Small Industries Development Corporation
SOP - Standard Operating Procedure
WHO - World Health Organization

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