IECMA 2026 Conference

The 3rd International Electronic Conference on Machines and Applications

12–14 May 2026 | Online

MDPI

Development of an automated kurut production system for industrial applications

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INTRODUCTION & AIM

Kurut is a traditional fermented dairy product that has been produced and consumed for centuries in Central Asia. Its dried form provides long shelf life and ease of storage, which historically made it suitable for nomadic and semi nomadic lifestyles. The name kurut originates from the Uzbek verb meaning to dry, emphasizing dehydration as the key technological stage of production.[1]

From a nutritional standpoint, kurut is a concentrated dairy product containing proteins, minerals, vitamins, and bioactive compounds formed during fermentation. Low moisture content contributes to product stability and reduces the need for chemical preservatives. Despite these advantages, the basic technological principles of kurut production have changed little over time and remain largely based on manual operations.

One of the most critical stages of traditional kurut production is shaping. This operation is commonly performed by hand, resulting in variations in size, geometry, and surface characteristics of the final product. Manual handling also increases labor intensity and creates direct contact between the product and the surrounding environment, which raises the risk of microbiological contamination. These factors limit productivity and complicate compliance with modern hygienic and sanitary requirements.

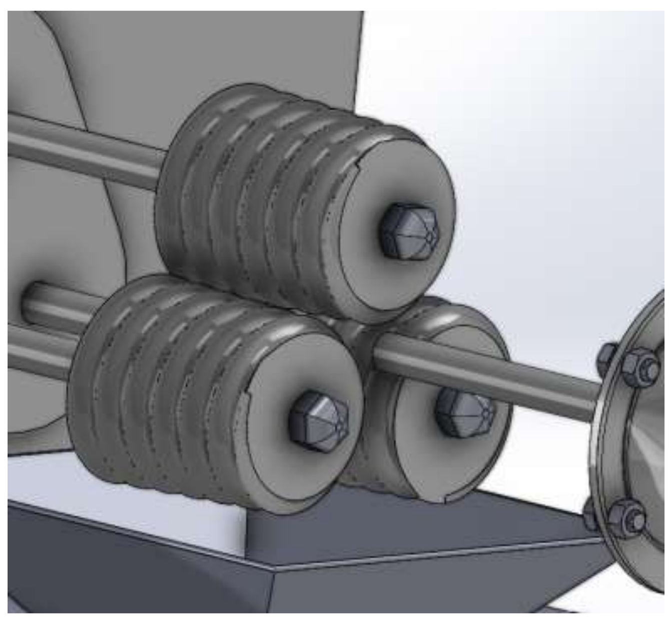
In recent years, growing consumer demand for safe, standardized, and industrially scalable traditional foods has highlighted the need for technological modernization. Automation of key production stages is considered an effective approach to improving process efficiency, reducing human involvement, and ensuring reproducible product quality. Controlled processing conditions also allow better protection of the product from external contamination.[2]

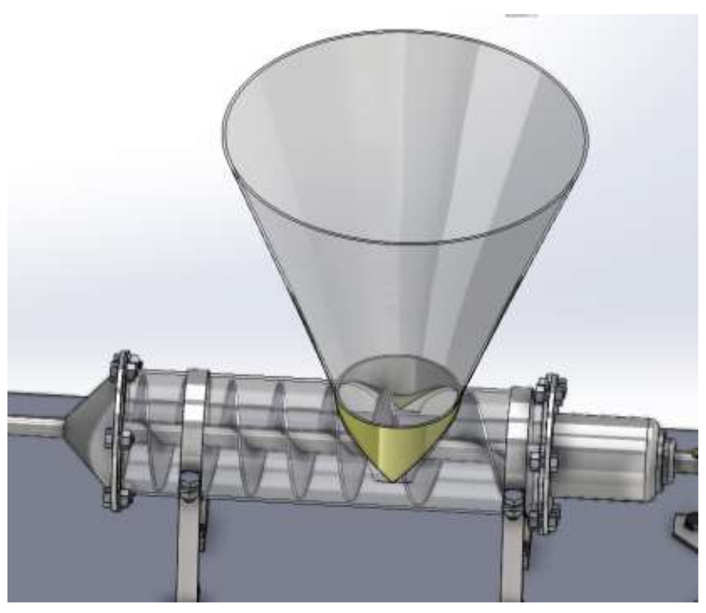
The objective of the present study is to further develop and evaluate an automated apparatus for kurut production based on previously proposed design concepts. Particular attention is given to the shaping stage, process stability, and hygienic safety. The proposed system aims to reduce labor intensity, improve uniformity of the final product, and create a controlled processing environment overall.[3]

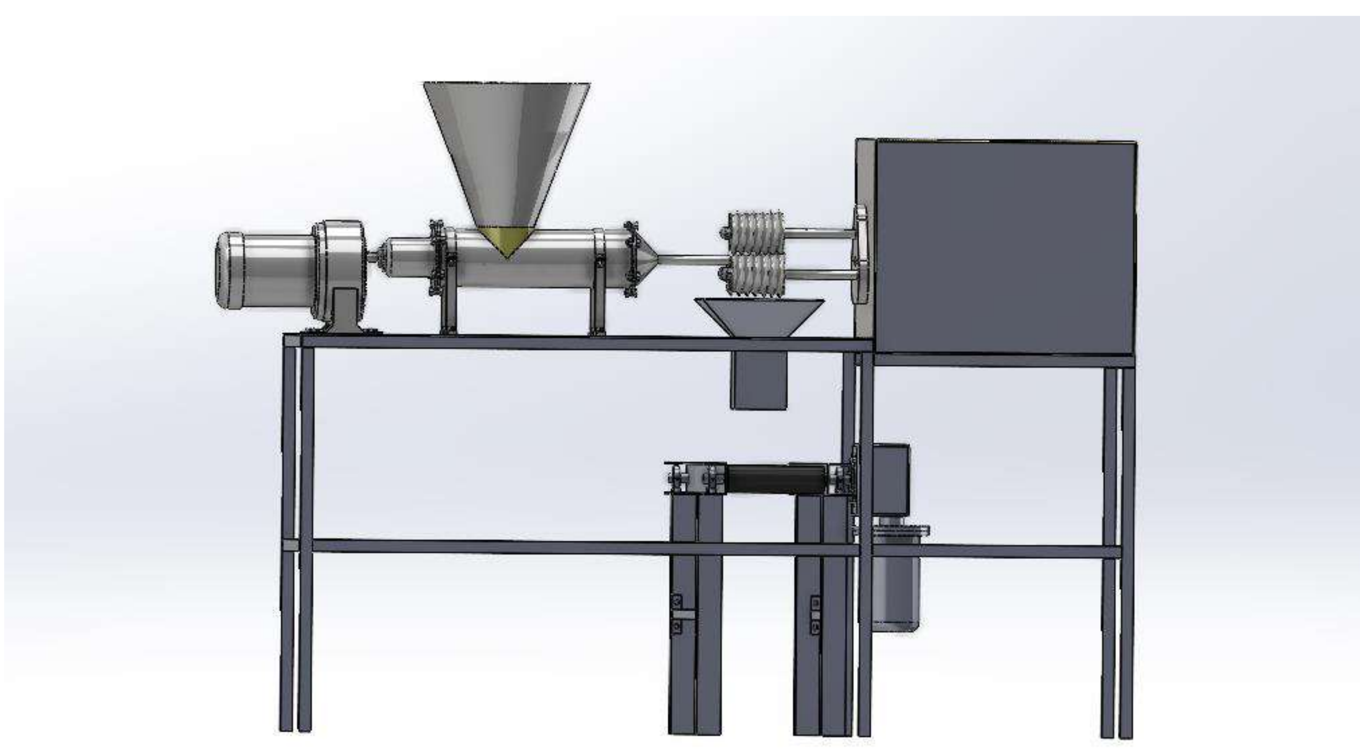
METHOD

To create the automated device, design methods in the SolidWorks program were used . The main parameters and components of the device:

1. **Forming Roller** : Project of the forming roll part of capsule equipment:
The rear part of the shaft has a diameter of 100 mm.
The diameter of the front part of the shaft is 90 mm.
Shaft length 110 mm.
Shaft shape size: diameter 17mm, shape pitch 17mm, revolution 7.75.
Starter shaft mounting hole diameter: 20 mm.
Veneer cutting: width 10 mm, height 5 mm.
2. **Main shaft** : Project of the main shaft of the capsule equipment:
Total shaft length: 400 mm.
The shaft consists of 8 parts with different parameters:
Front: diameter 19mm, length 280mm, groove for key 18mm long, width 10mm, depth 7mm.
Thread: length 12 mm, pitch 2 mm, chamfer 1.5 mm (45 degrees).
Length for bearing installation: 12mm, diameter 20mm.
3. **Bearings** : Main shaft bearing design:
External diameter: 40 mm.
Inner diameter: 20 mm.
Width: 10 mm.
External and internal thickness of bearing housing: 2.8 mm.
Ball diameter: 7.2 mm (10 pieces, 36 degree arrangement).
4. **Frame and body** : Project of the frame of the body of the forming part:
Length: 540 mm, height: 440 mm, width: 540 mm.
Profile: 20x20 mm, thickness 3 mm.
5. **Conveyor System** : Belt Conveyor Project :
Conveyor belt length: 1050 mm.
Width: 200 mm.
3mm thick silicone rubber tape.
Drive: 1.5 kW gear motor, 72 revolutions.
6. **Auger Extension** : Shaft Auger Project:
Overall length: 734 mm.
Working length of the auger: 600 mm.
Shaft diameter: 20 mm.
Key from shaft edge: 31 mm.
Key size: 18x10mm, depth 5.66mm.
Back cover: diameter 43 mm.
Funnel height: 300 mm, internal diameter: 113.63 mm.
Each component has been designed for optimum efficiency and compatibility with modern manufacturing requirements.







RESULTS & DISCUSSION

The developed automated device demonstrated a substantial improvement in production performance. The production rate increased by approximately 40% compared to the conventional manual method. This increase was achieved by reducing the time required for forming each individual product, which in turn enabled a higher output of finished products within the same operational time.

One of the key advantages of the automated system was the improved uniformity of product shape and texture. Precise adjustment of the forming mechanism ensured consistent geometry and surface characteristics of the products. As a result, the final products exhibited a more aesthetically appealing appearance, which positively influenced their consumer perception and market value [3].

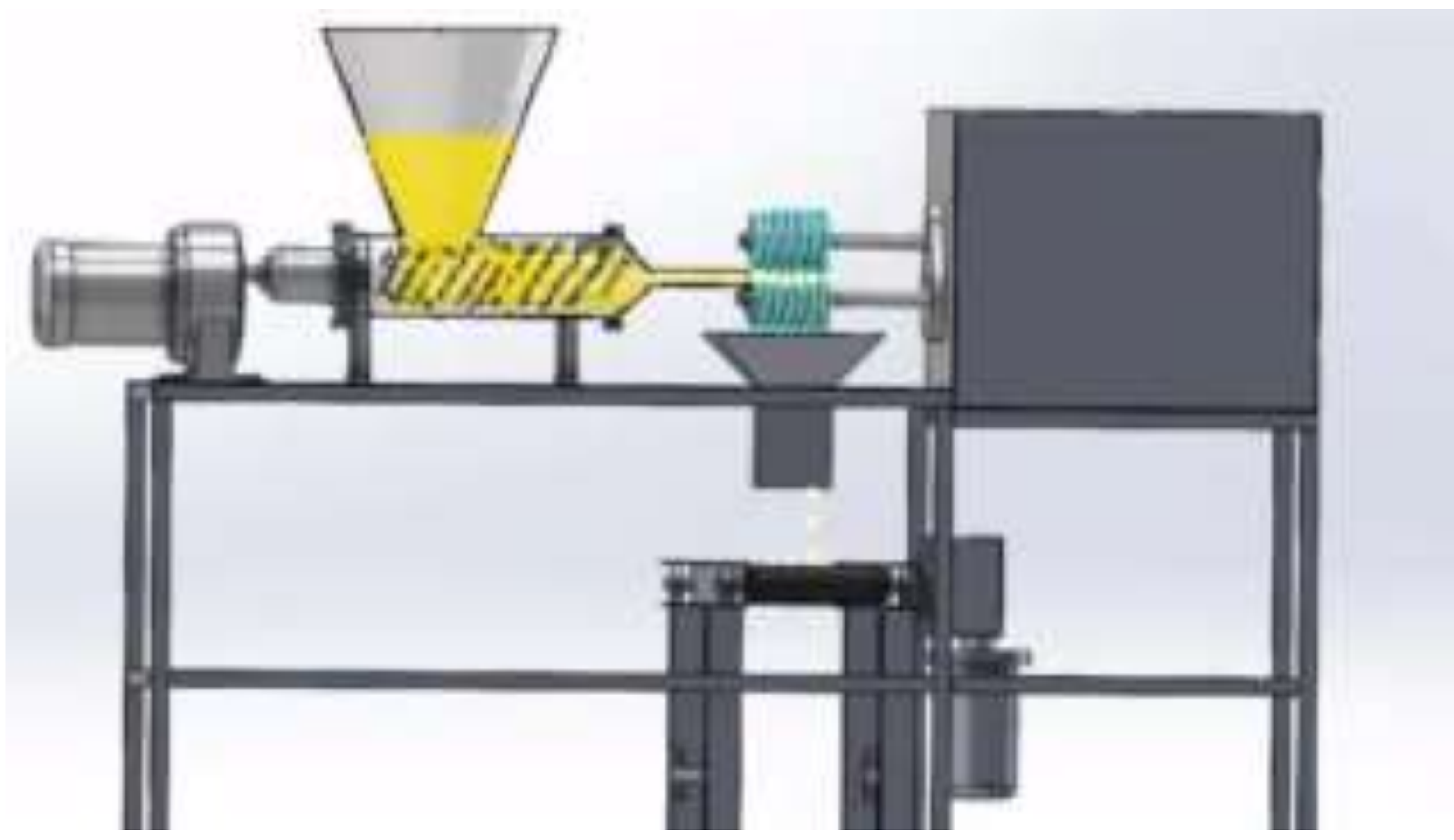
Automation also contributed to a significant reduction in the risk of microbiological contamination. The use of a closed processing system minimized direct contact between the product and the external environment. This factor is particularly important in food production, where hygienic conditions play a decisive role in ensuring product safety and quality.

The economic efficiency of the proposed device was confirmed during the study. Reduced labor costs, increased productivity, and a decrease in product losses collectively demonstrate that the implementation of such equipment is economically justified and promising for large-scale production.

The development of the automated device represents an important step toward improving the technological processes involved in the production of fermented dairy products. The high level of automation significantly reduces the influence of the human factor on product quality, which is especially critical in industrial-scale manufacturing where process stability and repeatability are essential [4].

Furthermore, the introduction of automated shaping and closed processing contributes to compliance with modern quality and food safety standards. By minimizing the risk of microbiological contamination, the proposed system enhances the overall reliability of the production process and increases the competitiveness of the final product in the market.

The obtained results confirm that the integration of automation into traditional kurut production not only improves efficiency but also creates favorable conditions for industrial scalability. In the context of growing consumer demand for natural, safe, and standardized food products, the proposed technological solution can be considered a promising direction for the modernization of traditional dairy processing technologies.



CONCLUSION

The developed automated device demonstrated a significant improvement in the technological process of kurut production. Its implementation allows a reduction in manual labor intensity, improvement in product quality, and an increase in production capacity. The use of automation also contributes to greater process stability and uniformity of the final product. The obtained results confirm the feasibility and effectiveness of applying automated technologies in the production of traditional fermented dairy products and indicate their potential for industrial-scale implementation in the food industry.

FUTURE WORK / REFERENCES

Future research will focus on improving the design of the automated device, expanding experimental validation under industrial conditions, and optimizing technological parameters to further enhance productivity, energy efficiency, and product quality.

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