AN EFFICIENT MEAT-BONE SEPARATING EQUIPMENT AND THE RELEVANT METHOD

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Abstract – Meat-bone separating equipment for materials like chicken bone and fish bone was designed, built and tested. This equipment consists of transmission system, crushing system, separating system, and transportation system. Initially, the untreated bone was crushed into small pieces by the double broken screw. And then the meat and bone was separated in a tapered separating sleeve. The particle size of final bone was about 2.0 -3.0 mm. The meat separation rate was about 90.5%, and the bone extrusion rate in meat was no more than 0.1%.

Key Words –Bone, Meat, Separator

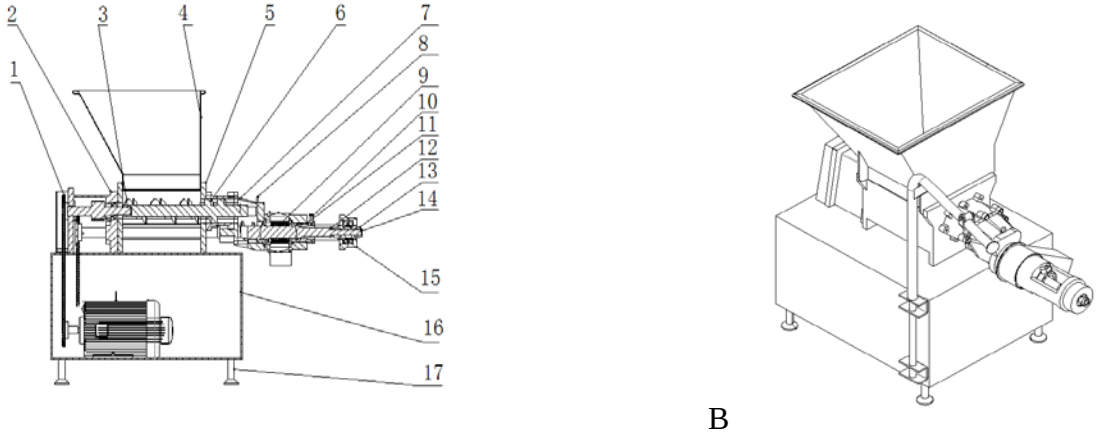
I. INTRODUCTION

The bones from livestock and poultry are rich in proteins, lipids, minerals and other nutrients, and it is worthy to make good use of those bones [1]. Particularly, bones from poultry and small animals are hard to be deboned manually and the meat on the bone accounted for 40~60% in weight. Therefore, the separation of meat is a critical step in the bone processing industries. The machine currently available for meat-bone separating are based on a cylindrical separation sieve sleeve with slot holes, thus some bone residue will be squeezed out along with the meat pastes. Besides, the final bone residues usually contains large ratio of meat due to the lower squeezing pressure at the end of the screw rod [2]. In this study, an efficient meat-bone separator was invented to improve the production efficiency.

II. MATERIALS AND METHODS

Equipment Composition

This equipment consists of transmission system (the motor, motor reducer, chassis, chains, chain wheel etc.), crushing system (adjustable twin screw roller, broken roller pulley etc.), separating system (tapered single screw rod, separating sleeve, screw bearing etc.), and transportation system (Fig.1-A and Fig.1-B).



A B

Fig.1 Schematic view of meat-bone separating equipment. A. Cutaway view of the equipment. B. Lateral view of the equipment.
1 Chain wheel, 2 Transmission case, 3 Gear shaft, 4 Inlet, 5 frame, 6 Broken shaft, 7 Tapered sleeve, 8 Rings, 9 Separating sleeve, 10 Tapered single screw, 11 Spinning Nut, 12 Cover, 13 Fasten the screw nut, 14 Extrusion axis, 15 Bearing, 16 Machine base, 17 Machine feet

Mechanism of crushing system

The key component of crushing system is the adjustable double broken screw (Fig.2-A). The double broken screw is consisted of two rollers with sharp screw blades (Fig.2-B). There is a driving wheel at one terminal of the driving roller which connects with the chain wheel. The exterior gears of the driven wheel are engaged with the exterior gear of the driving wheel, thus providing driving force for the driven roller. The sharp screw blades on the driving roller

and driven roll interlace sequentially. The driving roller and the driven roller rotates are in the reverse direction, squeezing and biting the raw materials and finally crushing the raw materials to qualified pieces (0.1~0.5 cm in size).

Mechanism of separating system

The separating system locates below the crushing system. The key components of the separating system are taper single screw rod (right handed helix, Fig.2-C) and separating sleeve (Fig.2-D). The unique taper screw rod has varying pitch of the screw leaf and varying thickness of the screw leaf. The rotation speed of the taper single screw rod is 200 - 400 rpm/min. The separation parts of the taper single screw rod cooperate with the separating sleeve. The separating sleeve is a circular truncated cone with circular pores and it matches the taper single screw rod. The angle between tapered edges and axis is 4º. The diameter of circular pores inside the sleeve is larger than that outside. The sizes of the pores decrease gradually from the wide side (1.8 mm) to the narrow side (1.0 mm) of the separating sleeve. Besides, the density of pores in the wide side (1/cm^2) is less than the narrow side (6/cm^2). This design can reduce the bone residue rate in meat pastes to a great extent.

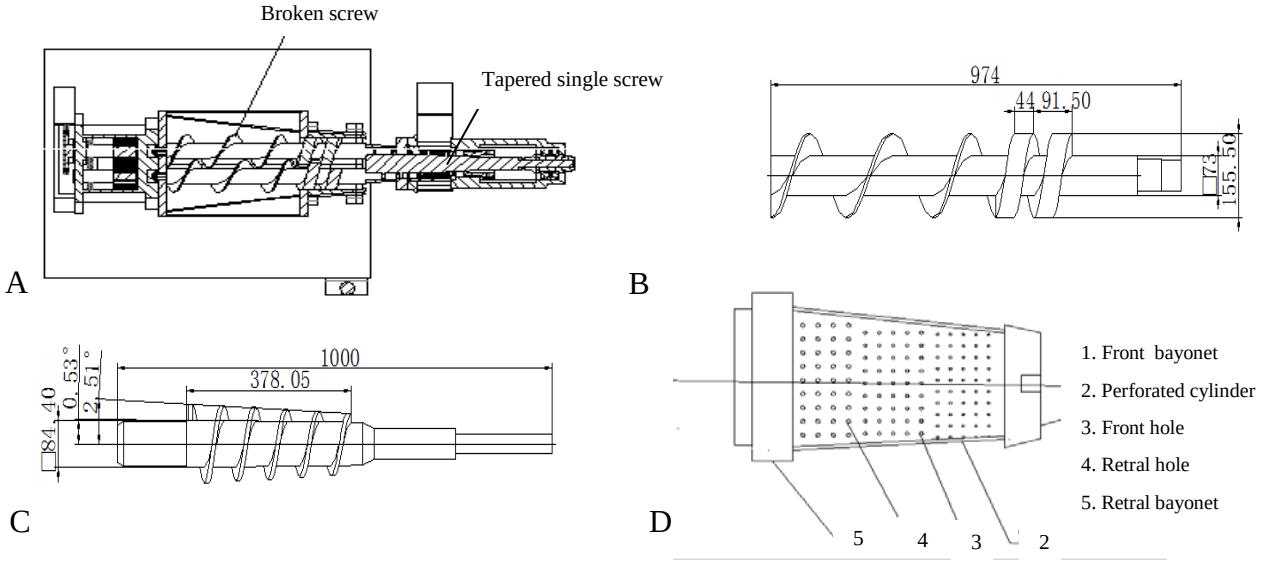


Figure.2 Schematic view of the individual parts. A. Double broken screw, B. Single broken screw, C. Separating sleeve, D. Tapered single screw.

III. RESULTS AND DISCUSSION

Here is an example on how the meat-bone separator worked. Frozen chicken skeletons were thawed to -1~1℃, and transported to the inlet port. The adjustable double broken screw (Fig. 2-A), which under the inlet port, crushed chicken skeleton into small pieces with the diameter of 0.1 cm to 0.5 cm. Then the crushed material was pushed from tapered single screw (Fig. 2-C) into the separating sleeve (Fig. 2-D). Finally, the meat paste was squeezed out through the holes of sleeve, and the bone residues squeezed out through the terminal of the separating sleeve. The meat separation rate was about 90.5%, and the bone extrusion rate in meat was no more than 0.1%. The particle size of the final bone residue was about 2.0 to 3.0 mm.

IV. CONCLUSION

The meat-bone separator was developed based on designed components, and evaluated. The meat-bone separator has a large potential for livestock and poultry bone processing industries.

ACKNOWLEDGEMENTS

The authors thank National Agricultural Science and Technology Innovation Program for financial support.

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