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Design and Fabrication of a Three Phase Poultry Bird De-feathering

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Introduction:
One of the most important aims of poultry production is to obtain meat for consumption in various quarters. As these meat products are being demanded for, cleanness and hygiene is highly expedient, hence adoption of processing methods which are capable of delivering the required standard. A number of important activities are involved in the production of ready-to-cook poultry products, large percentage of which are labour intensive and these contribute to the high cost of processed poultry meat in the market (Lucas and Adetola, 2013). Defeathering takes the longest duration when done manually, it is tedious and limits the production per time and also allow much contamination due to touches on the skin. Plucking machines, though existing in different forms in many developed countries, its presence in Nigeria is yet unpopular partly because of its cost or poor orientation of the poultry farmers on its functionality and operation parameters. Therefore, exploitation of the mechanical defeathering process by designing, fabricating and evaluating an efficient,strong and easy-to-use defeathering machine is expedient.

Materials:
For the testing of the machine, thirty (30) Isa brown spent hens (old layer birds) were purchased from Elesin Farm in Ilaro, Ogun State and were transported to the processing laboratory of Agricultural and Bio- Environmental Engineering department of the Federal Polytechnic Ilaro. The spent hens were fed only up till the night before the experiment as it is the practice in slaughter houses. A temporary confinement was provided for the hens where they were placed before being picked up for the experiment. Other materials and equipment used during the research includes electronic weighing balance, thermometer, stop watch, measuring cylinder, thermostat, thermocouple, electric heater, water pump, electric motor, water pipes while a tachometer was used during the calibration of the variable resistor system for effective speed regulation.

Experimental Method:
The slaughtered birds were dipped into the scalding water for a period of 1minute, this was constant for all experiments. The slaughtered birds were weighed on a digital scale before scalding, and the scalded birds were also weighed before they were de-feathered. The remaining feathers on the birds were removed by hand and weighed to quantify the percentage feather remaining on the birds. The final weight of carcass was also recorded. This same procedure was repeated for all scalding temperatures and feather plate speeds (rotor speed).
Five different scalding temperature was used to evaluate the effect of scalding temperature on defeathering, the temperatures are 00C (room temperature), 300C, 500C, 700C and 1000C. After scalding the birds for a period of one minute, the birds were placed in the defeathering chamber and de-feathering commences immediately while water of the same temperature as the one used for scalding was continuously pumped into the defeathering chamber throughout the de-feathering operation. Water temperature was kept constant for each experiment by the water heater. The defeathering machine was powered by a 2hp, 1.5Kw electric motor of 1500 revolution per minute. The effect of feather plate speeds (rotor speed) was also evaluated on defeathering, three speeds (360 rpm, 280 rpm and 200 rpm) were used to determine if rotor speed has effect on feather retention and de-feathering efficiency.

Results and Discussion:
Descriptive analysis of the evaluating parameters (feather retention, plucking efficiency and the defeathering time) in relation to the varied operating parameters (feather plate speed and scalding time) are shown in the table below.
Where:

- Wd is dry weight of slaughtered bird before scalding Ww is Wet Weight of slaughtered bird after scalding
- Wad is Weight of bird after defeathering
- Wfm is Weight of feathers removed by the machine
- Wfh is Weight of retained feathers on defeathered bird which was removed by hand

Conclusions and Recommendations:
The chicken feather plucking machine was designed, fabricated and its performance was tested. Three speeds of 200, 280 and 360 rpm were adopted and 5 scalding temperatures which are the room temperature (00C), 30°C, 50°C, 70°C, and 100°C were adopted for birds scalding before they were defeathered. Results obtained showed that the feather retention decreased as the speed increased but the ANOVA result of 0.72 shows that speed has no significant effect on feather retention. This also applies to the plucking efficiency. However, the highest plucking efficiency of 98.5% was obtained at 360 rpm speed and 100°C scalding temperature. Based on physical evaluation and the results obtained speeds of 280 rpm or higher were recommended to operate the machine and the scalding temperature of 70°C is recommended. On a general note, the machine functioned well and inflicted minimal or no damage on the processed birds.