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Comparative Plucking Force Characterisation of Chicken Produced From Two Breeds of Chicken

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ABSTRACT

The conversion of a live chicken into safe and wholesome meat products suitable for human consumption takes place in a series of processing steps. Few of the processes require force to carry it out successively among which are slaughtering and de-feathering. The latter is the focus in this paper, plucking force of chicken produced from two breeds of chicken. Each sample of the chicken carcass was loaded into the hanger and lowered into the rotary drum for plucking one at a time. The process took an interval of one minute from one temperature to another in order to determine the appropriate plucking force. The results obtained for plucking contour and down feather of local chicken carcass were 11.26N and 2.44N respectively at 85^{o}C for 5 minutes. The corresponding values for the exotic breed carcass in the order listed above are 4.13N and 1.02N respectively at temperature of 70^{o}C for 3 minutes. The results obtained showed that the two samples of chicken examined would meet-up with daily demand in relation to production rate domestically.

Keywords: Chicken, Contour, De-feathering, Down, Plucking-force.

I. Introduction

The optimum use of energy is of great concern in any manufacturing industry. The poultry processing firms are not exempted. Thus, the quality of the product is of interest to both the customers and the management of the poultry processing firms [1]. Poultry processing has faced challenges that are of safety and health concern, some of which include task that could result in cuts on lacerations, repetitive motion disorders, slips and falls, exposure to cold and wet climates, dust, dermatitis, chemicals and noise [2],[3],[4].

[5] reported that poultry meat contributes substantially to the human diet. In order to optimize energy and overcome difficulties involved in manual de-feathering process of chicken several factors such as scalding temperature, duration of immersion, age of the chicken and feather retention force determine the quality of the final product [6]. A number of important activities are involved in the production of ready-to-cook (RTC) poultry, a large percentage of which are labour intensive and these contribute to the high cost of processed poultry meat in the market. Identified production processes for eviscerated birds are (i) Pre-slaughter, catching and transport, (ii) Immobilizing, killing and bleeding, (iii) Feather removal, scalding and plucking, (iv) Removal of head, oil glands and feet, (v) Evisceration, (vi) Chilling, (vii) Cut-up, de-boning and further processing, (viii) Aging, (ix) Packaging, (x) Storage and (xi) Distribution. Among the listed processes, feather removal is the most time consuming and risky next to eviscerating process especially when carried out manually [7].

Feather structure of the locally available chicken in Nigeria is similar to that of the exotic type but experiment on this study base on the indigenous local chicken shows that there are factors which affect feather structure of both the exotic and local chicken which are more severe on the indigenous chicken which may be responsible for the feather retention force (FRF) of the indigenous bird compared to exotic is evident and significant through the scalding temperature and immersion duration. The factors are as follows: Nutritional factor, Physical environment, Sex differences, Age, Physiological control of feather [8].

Various machines have also been developed for de-feathering process which can handle either large or few number of birds [9]. However, their demand and acceptance are different from one continent to the other. Some years ago for instance, Nigerian government banned importation of some poultry processed meat. This step placed a boost on the operation of indigenous poultry industry and allied. This study is focused on comparing the feather plucking force in relation to immersion duration for both exotic and indigenous birds in south-western Nigeria. The developed machine which performance test and evaluation is being presented has the potential of enhancing safety, comfort and economic production of RTC birds.

Development of small scalding and plucking machines though exist in different forms in many developed countries. It's presence in Nigeria is yet unpopular partly because of its cost which is unaffordable by many. This contributes to the high

cost of processed chicken in the market as well as the choice of manual poultry processing methods by various households in Nigeria.

II. Materials and Methods

The selected birds for this study were matured local and exotic chickens. Sample of local and exotic birds with average mass of 1.50 and 3.50kg respectively were chosen.

For the experimental aspect of the work, a poultry de-feathering machine was developed and evaluated. Material used for the construction of the de-feathering machine was majorly mild steel. Mild steel was preferred because it is widely available, strong, cheap and easy to fabricate. The de-feathering machine consists of three identifiable assemblies with their functional components. These are base unit (cast-turn, table frame, top plate, cross member, coupling, electric motor, pulley and belt), housing unit (frame cover, the drum, drum support, bolt and nut, rubber fingers and bearing) and the over-hanged unit (the hanger, crank rod, handle and rope).

Factors considered in the design of the machine in other for it to be suitable for eatery and household use (e.g cutleries, machine and kitchen tools) are safety, portability, low cost of production, production capacity, durability of fabrication materials, materials availability, ease of alteration, finishing, reliability and ease of operation.

The de-feathering process started with the manual feeding of bird whose feathers are to be plucked by the machine. The chicken which has just been soaked in hot water is lowered into the de-feathering mechanism by winding the feeding mechanism made of simple crank rod with wooden handle. The bird being lowered down into the de-feathering mechanism which is made of galvanized steel drum lined internally with rubber fingers subjected into a rotary motion by the transmitted torque from the electric motor. The carcass is rubbed with the rubber fingers and the feathers are thereby plucked continuously until the bird is completely de-feathered.

For the test procedure, a lagged container was half filled with water which was heated using boiling ring. A thermometer was introduced to check the temperature intermittently. A stirrer was used to agitate the heated water to ensure uniformity in temperature. The hot water was poured inside the drum and a test temperature for scalding was maintained inside the drum. At different temperature of 40^{o}C, 45^{o}C, 50^{o}C, 55^{o}C, 60^{o}C, 65^{o}C, 70^{o}C and 75^{o}C the exotic breed was dipped in the hot water and held in water for 1minute, 2 minutes and 3 minutes. Similar test was carried out on local bird at temperature of 40^{o}C, 45^{o}C, 50^{o}C, 55^{o}C, 60^{o}C, 65^{o}C, 70^{o}C, 75^{o}C, 80^{o}C, 85^{o}C and 90^{o}C, for 1 minute to 10 minutes. A stopwatch was used to ensure accurate immersion duration. For each temperature and immersion duration the scalded chicken was transferred to the test machine and de-feathering was carried out in three replicates.

The plucking force was then recorded. The plucking force for the un-scalded birds was also measured with the use of Feather Stiffness Meter (FSM) fixed on the fabricated de-feathering machine.

III. Results and Discussions

Feather retention forces of chicken carcasses from un-scalded local and exotic chicken feather are shown in TABLES 1 and 2. It was found that close to two-third of retention force required to pluck contour feather of an un-scalded local chicken is needed for similar operation on exotic bird and about half of retention force require for the down feather of local chicken is needed for that of exotic bird while TABLES 3 and 4 shows the results at different level of force required to pluck-out feathers at different scalding temperatures for both mature local and exotic breeds of chicken because there were no good results on the under-age chicken of any kind. The higher value shown by feather stiffness of local chicken suggests higher plucking force and consequently higher scalding temperature compare to that of exotic bird.

Fig.1 shows the de-feathering machine in operation. Both contour and down feather were plucked with varying force measures with feather stiffness meter. From the result of plucking force, adequate plucking force for local bird (i.e both for contour and down feather) were 11.26N and 2.44N respectively at 85^{o}C for 5 minutes while that of exotic bird were 4.13N and 1.02N respectively at temperature of 70^{o}C for 3 minutes. The temperature at which the exotic bird was appropriately de-feathered is within the range of 60^{o}C - 70^{o}C recommended by [3].

Other results of plucking force for local bird both for contour and down feather at other temperature considered gave 56.93N and 26N, 54.23N and 23.12N, 50.16N and 20.18N, 46.02N and 18N, 45.03N and 16.97N, 35.70N and 11.64N, 34.81N and 11.26N, 24.67N and 10.12N, 14.05N and 3.73N, and 10.37N and 1.76N respectively. The corresponding values for exotic bird at temperatures below the appropriate scalding temperature and plucking force gave 29.70N and 11.30N, 28.96N and 10.96N, 26.90N and 9.47N, 19.70N and 4.45N, 16.99N and 4.06N, 11.12N and 2.59, and 3.63N and 0.96N respectively.

Fig. 2 and 3 reveal the actual difference in feather retention force (FRF) that exist between the two types of chicken and feathers under study, while Fig. 4 shows the finished de-feathered chicken with a good appearance without any scar having little or no pin feather not being de-feathered. The amounts

of plucking force for the two birds examined are very satisfactory as they contribute immensely to the physical appearance and economic production of ready to cook (RTC) birds. The low plucking forces in both contour and down feather of exotic bird is expected due to the age, nutrition, environment and physiological factor.

Figure 1: The de-feathering machine operation

Table 1: Force Required to Pluck-out Feather from Un-scalded Local Chicken

Trial	Force to Pluck-out Contour Feather (N)	Force to Pluck-out Down Feather (N)
1st Trial	44.60	13.60
2nd Trial	42.00	11.90
3rd Trial	38.00	12.12
Total	124.60	37.62
Average	**41.53**	**12.54**

Table 2: Force Required to Pluck-out Feather from Un-scalded Exotic Breeds

Trial	Force to Pluck-out Contour Feather (N)	Force to Pluck-out Down Feather (N)
1st Trial	28.88	5.80
2nd Trial	26.00	7.06
3rd Trial	22.50	8.46
Total	77.38	21.32
Average	**25.79**	**7.11**

Table 3: Force Required to Pluck-Out Contour Feather at Varied Temperature

Temperature (^oC)	Force for Local Chicken (N)	Force for Exotic Breeds (N)
50	50.16	26.90
55	46.02	19.70
60	45.03	16.99
65	35.50	11.12
70	34.80	4.13
75	24.00	3.63
80	14.50	3.00
85	11.26	2.45
90	10.37	2.00

Table 4: Force Required to Pluck-Out Down Feather at Varied Temperature

Temperature (^oC)	Force for Local Chicken (N)	Force for Exotic Breeds (N)
50	20.18	9.47
55	18.00	4.45
60	16.97	4.06
65	11.64	2.59
70	11.26	1.02
75	10.12	0.96
80	3.73	0.91
85	2.44	0.86
90	1.76	0.81

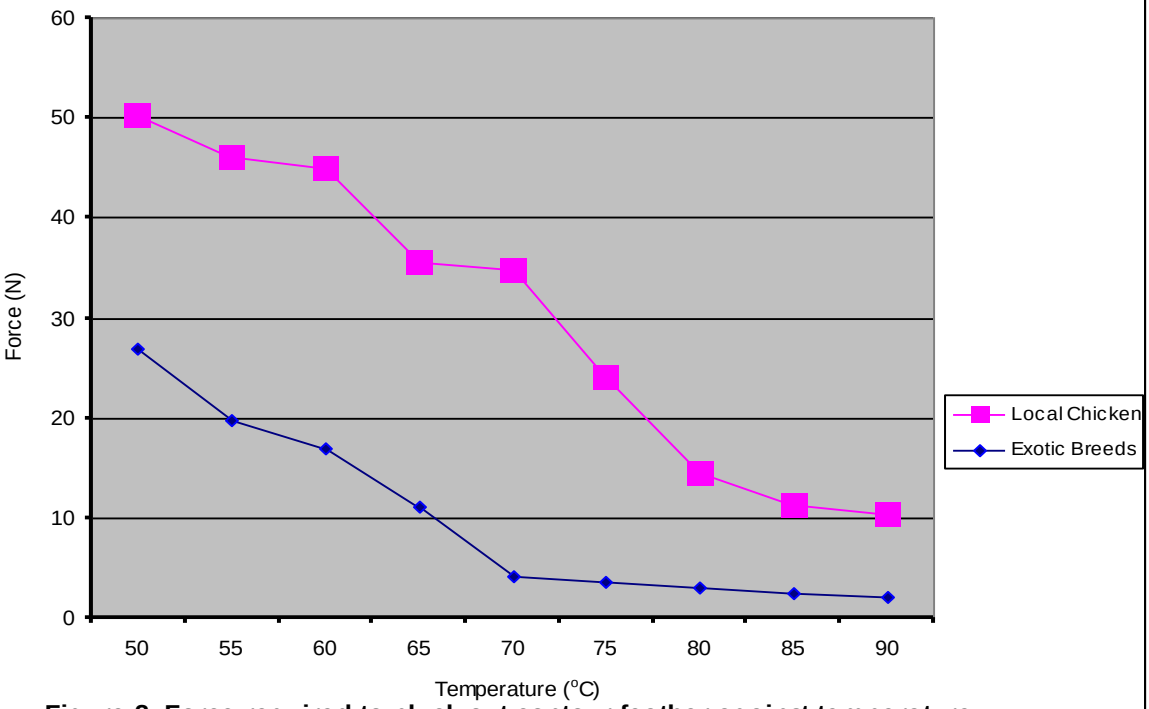

Figure 2: Force required to pluck-out contour feather against temperature

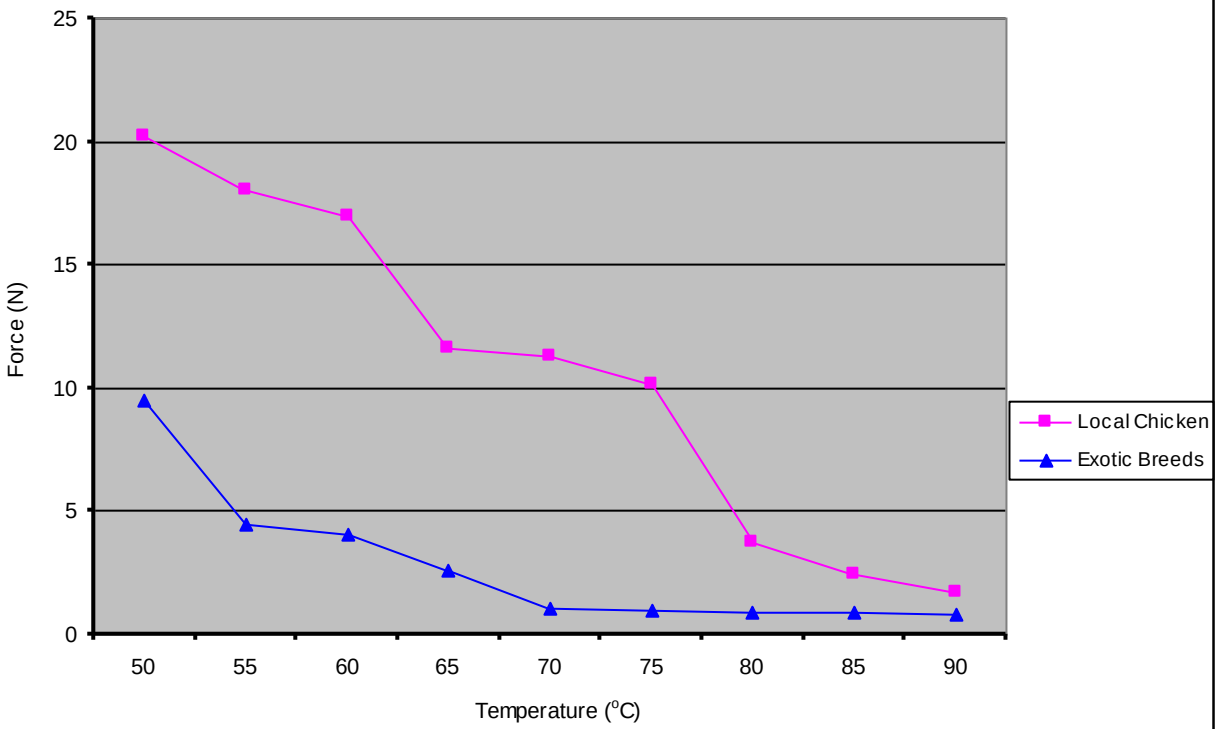

Figure 3: Force required to pluck-out down feather against temperature

Figure 4: The finished de-feathered chicken

IV. Conclusion

The present work examined the comparative plucking force characterisation of chicken produced from two breeds of chicken. This was achieved by subjecting the two breeds into a proto-type poultry de-feathering machine. Thereafter, the physical appearances of the meat product from the breeds were examined.

Based on the various results obtained from the study, the following conclusions can be drawn:

1. Meat products from local and exotic breeds would make good chicken.
2. The chicken produced from both local and exotic breed was of good appearance and will make for good market value.
3. The average scalding temperature range obtained for both local and exotic breed were sufficient and reasonably adequate. It means that, products will suffer less damage during plucking and packaging.
4. The chicken produced from local breed require more plucking force both for contour and down feather than chicken produced from exotic breed.

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