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Effect of Slaughter Operations on the Microbial Load of Broiler Duck Carcasses

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ABSTRACT

The study was undertaken to identify the microbial load of broiler duck in the commercial duck processing line with respect to faecal contamination. The surface swab samples of duck were collected at different processing steps, for the enumeration of Escherichia coli count and coliform count. Study was carried out for six batches and swab samples were collected before stunning, after scalding, after defeathering, after evisceration, after singeing and washing, after pre-chilling and draining, after chilling just before packing and two days after freezing. Significant ($p<0.01$) difference was noted for E. coli, and coliform among different steps in the duck processing line. The highest E. coli and coliform the highest and the lowest count was noted before stunning and after singeing and the values were 3.64, 0.4 and 3.52, 0.55 $log_{10}cfu/cm^2$ respectively. A significant ($p<0.01$) reduction in E. coli and coliform count was noted after scalding, after singeing and after freezing for two days at -20^oC. Based on the significant ($p<0.01$) increase in the microbial load at different processing steps different control points for biological hazard were identified in the duck processing line viz., during defeathering, evisceration and immersion pre-chilling.

Key words: *Duck processing, E. coli, coliform, Surface swab,*

INTRODUCTION

Duck population is mostly concentrated in the Southern and Eastern States situated mainly around the coastal belt. In Kerala, duck rearing has tremendous scope and potential. It is a highly lucrative livestock industry its egg and meat are of high aesthetic value.

As per livestock census 2012, the duck population of India is 23.54 million comprising of three per cent of total poultry population[7]. The constant demand for the duck meat is increased in India the meat production has increased to total 5.9 million tonnes of which comprises 45% from poultry meat alone but duck farming has not undergone much change in commercialisation or industrialisation in duck meat processing as that of chicken in India but the growth and popularity is steady.

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Currently China is the largest producer of duck meat (2,988,408 tonnes annually) followed by France and Malaysia[8].

The main aim of poultry processing plant thought the world is to process poultry scientifically to save labour and maximise output with minimal wastage. Poultry meat are prone to microbial contamination from number of sources. The bird itself is a major contributor of both spoilage and pathogenic organisms. Further contamination may come from water, plant equipment's and from the operators handling the duck which adds to the microbial hazards that arise when the desired measures is not achieved and is usually due to errors in the handling or processing procedures. The detection of such errors, their rapid correction and future prevention is a major objective of any Food Safety Management System (FSMS). FSMS must be implemented from production through processing, storing, transporting, merchandising and the ultimate use in the food service in order to produce safe meat and producing products with greater consumer confidence and acceptance. The present study was undertaken with the broad objective to identify the biological hazards (E. *coli* and coliform) that occur in the production to process chain.

MATERIAL AND METHODS

The birds were shackled manually into the conveyor system. The stunning of the birds were done in an electrical water bath kept at a voltage of 70 volts The birds were bled by an operator with a stainless steel knife cutting across the jugular vein and carotid artery after making ventral neck cut. Bleeding was carried out for 2 min. The birds were subsequently hard scalded by immersion scalding at 60-64^{o}C for 2 min in the scalding tank, defeathered in a defeathering machine, singed and washed manually. Evisceration was carried out using hand. The carcass was pre-chilled for 10-15 minutes at 7-12^{o}C after evisceration and chilling was done at 4^{0}C followed by aerobic packing then freezing at -18^{o}C for two days before despatch.

For assessing the level of faecal contamination in the duck carcasses at the processing by *E. coli* and coliform organisms a total of 480 swab samples comprising of 60 samples each at each step of processing was done after leg and wing tagging of ten ducks were done for easy identification in the duck processing line at an equal interval of ten and the experiment was replicated for six batches.

Microbial analysis procedure involved taking a swab of a specific area, and then plating out dilutions onto a growth medium which results in growth of microbial colonies, The surface swab samples were collected from the breast region using (Hi-Media) PW-003 sterile cotton swabs with screw cap, the swab were moistened with 0.1 per cent peptone water before collection. A 100 cm^2 area of the breast surface to be examined marked with a sterile aluminium template. These swabs were transferred to a screw capped test tube containing 10 ml of sterile maintenance medium (0.85% Normal saline and 1% peptone**).** Tenfold serial dilution up to 10^{-4} dilution of all the samples was done using 0.1 percent Peptone water and the samples and serial dilution was made as per requirement. The 10^{-3} and 10^{-4} dilutions were taken for performing pour plating method for *E. coli* and coliform organisms after incubating for 37^{0}C for 48 hours. *Coliform* count and *E. coli* was estimated in accordance with[13].

DATA ANALYSIS

The data obtained were analysed statistically based on the methods described by Snedecor and Cohran[16], and utilizing the IBM SPSS version 24.0 version. Repeated measures ANOVA. Significant at 1% level with p value ($p<0.01$)

RESULTS AND DISCUSSION

The mini lorries with loose crate system was followed to transit the ducks from farm to the processing plant taken under study, during transit from farm to plant the birds were in

close proximity with each other and in contact with the faecal material from the group hence the highest microbial load was noted at the processing step before stunning. Which had a microbial count of 3.64 ± 0.22 and 3.52 ± 0.20 log_{10}cfu/cm^2 for *E. coli* and coliform respectively similar observations were also noted by Goksoy *et al.*[11], for *E. coli* and Mead *et al.*[15], Goksoy *et al.*[11], and Vaidhya *et al.*[18], for coliform.

After stunning and sticking the freshly slaughtered ducks were passed through the immersion scald tank in order to lose the feathers. This process removed the large number of microbial contaminants from the carcasses surface. The scalding process significantly ($p<0.01$) reduced 0.74 ± 0.21 and 0.99 ± 0.20 log_{10}cfu/cm^2 for *E. coli* and coliform count respectively as shown in the table 1. This significant ($p<0.01$) reduction in the microbial load after scalding may be due to the destruction of the microorganisms due to lethal effects of the hard scalding water temperature (64^{o}C for 2-3 minutes) similar observations were noted for *E. coli* by Lillard *et al.*[14], Vaidhya *et al.*[18], and Goksoy *et al.*[11], and for coliform count Mead *et al.*[15]. Goksoy *et al.*[11], and Vaidhya *et al.*[18], reported similar values.

Though most of the organisms of the duck carcasses were destroyed during scalding process but recontaminations were seen at the later stages of processing. During defeathering *E. coli* and coliform significantly ($p<0.01$) increased from 0.74 ± 0.21 after scalding to 2.33 ± 0.31 log_{10}cfu/cm^2 and 0.99 ± 0.20 after scalding to 2.44 ± 0.23 log_{10}cfu/cm^2 respectively. Increase in the microbial load during defeathering may be due to aerial dispersion of bacteria from scouring of carcass to remove the feathers or the carcass may have acquired contamination from the plucking machines. The results obtained in the present study For *E. coli* count after defeathering had values greater than reported by Berrang *et al.*[6], and Zwiefel *et al.*[19]. The increased coliform count in the present study was in agreement with the results reported by Mead *et al.*[15], Gill and Badoni[9] and Berrang *et al.*[6], with an increase in the microbial load after defeathering.

Evisceration of the carcasses using hand significantly ($p<0.01$) increased the value for *E. coli* and coliform respectively. Enteric organisms will be present in the faecal material of the gastro intestinal tract increase in the value of the microbial load may be due to use of improper techniques during vent opening, slitting and evisceration which lead to rupture of intestines and spillage of gut contents and also contamination from the processing operatives hands. Similar observations were also noted for *E. coli* count obtained after evisceration was less than that reported by Abu Ruwaida *et al.*[2], in ducks but greater than that reported by Gill *et al.*[10]. in chicken. This increase in microbial count from the previous step as reported in this study is in accordance with Barbut *et al.*[5], and but not in accordance with Svobodova *et al.*[17], where mechanised eviscerating machines were used. The increase in the coliform count was noticed in the present study which was more than the value reported by Gill and Badoni[9], suggesting further cross contamination from processing hands by operatives. This increase is significantly ($p<0.01$) different from the defeathering step is in accordance with the results reported by Mead *et al.*[15], and Vaidhya *et al.*[18], but not in accordance with Barbut *et al.*[5], where the values got reduced as the carcasses were dressed by mechanisation.

Flame singeing of duck carcass with a gas burner was done to remove the hair like appendages called filoplumes from the carcass and the singed carcass was then washed with water to ensure free from blood splashes, faecal contaminations and to remove the charred material. This step during duck processing significantly ($p<0.01$) reduced the count from 3.70 ± 0.24 and 3.17 ± 0.26 log_{10}cfu/cm^2 for *E. coli* and coliform respectively to 0.40 ± 0.15 and 0.55 ± 0.16 log_{10}cfu/cm^2 for *E. coli* and coliform count

respectively. Significantly ($p<0.01$) lowest count was noticed among all steps for *E. coli* and coliform. This may be due to high destruction of the microorganisms due to lethal effect of the high temperature of the blue flame used in singeing.

After singeing and washing stage the warm carcasses are pre-chilled promptly to prevent the growth of mesophilic and to limit the multiplication of the psychrophilic bacteria. After singeing and washing significant ($p<0.01$) increase in *E. coli* and coliforms were seen in the subsequent stage of immersion pre-chilling. This may be due to carcass to carcass contact and via the cooling media as hypothesised by Jimine'z *et al*[12]. The values obtained after the processing of pre-chilling and draining were 2.72 ± 0.28 and 2.17 ± 0.27 $log_{10}cfu/cm^2$ for *E. coli* and coliform respectively. And the values obtained after the process of air chilling for 12 hours were 1.95 ± 0.33 and 2.19 ± 0.29 $log_{10}cfu/cm^2$ for *E. coli* and coliform respectively. It is unsurprising to note chilling did not produce any significant ($p<0.01$) reduction in the number of bacteria on carcasses. The level of cross contamination noted during pre-chilling and further chilling for different batches varied and it depended on the earlier stages of processing especially during scalding, plucking and evisceration. The stage that followed chilling is packing and they involved further handling. After packing the packed duck carcasses were frozen for two days at temperature less than -18^0C before despatching for retail markets. The freezing of carcasses significantly reduced the *E. coli* and coliform to 1.62 ± 0.28 and 1.68 ± 0.28 $log_{10}cfu/cm^2$ respectively and freezing can be apparently operated to give a significant and differential destruction of *E coli* and coliforms. The microbial count after freezing was in range as reported by Abdallah *et al*.[1], in ducks and in agreement with the values before and after freezing reported in chickens by Abu Ruwaida *et al*.[2], in chicken respectively for *E. coli* and coliform counts. The microbial counts of the final broiler duck carcasses were well within the limits prescribed by FSSAI.

Table 1: *E. coli* and coliform count of duck carcasses at various steps in the processing line

Processing stage	*E. Coli* count	Coliform count
	Mean ± SE	Mean ± SE
Before stunning	3.64 ± 0.22^a	3.52 ± 0.20^a
After scalding	0.74 ± 0.21^b	0.99 ± 0.20^b
After defeathering	2.33 ± 0.31^c	2.44 ± 0.23^c
After handpicking and evisceration	3.70 ± 0.24^a	3.17 ± 0.26^a
After singeing and washing	0.40 ± 0.15^b	0.55 ± 0.16^b
After pre chilling and draining	2.72 ± 0.28^c	2.17 ± 0.27^c
Chilling for 12 hours and packing	1.95 ± 0.33^c	2.19 ± 0.29^c
Two days after freezer storage	1.62 ± 0.28^d	1.68 ± 0.28^d
F-Value	31.69**	28.76^{**}
P Value	<0.01	<0.01

Means bearing different superscripts in the same column differ significantly (P<0.01)
**significant at 1% level.

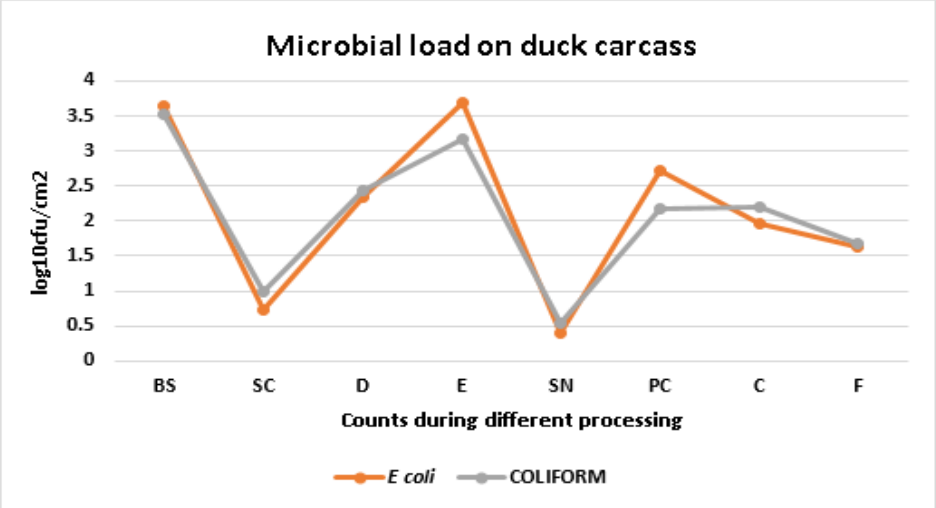

Fig: Microbial load on duck carcasses under processing for *E. coli* and coliform count.

BS-before stunning, SC-after scalding, D- after defeathering, E- hand picking and evisceration, SN-after singeing, PC- Pre-chilling F- Freezing -18°C

CONCLUSION

The microbial load in the duck carcass were within the limit prescribed by FSSAI for frozen meat. The biological hazards (microbial hazard) identified during duck processing line were Defeathering, evisceration and immersion pre-chilling. Upgrading of the facilities with proper consideration of working practice Pre requisite and operational prerequisite programmes is expected to improve the microbiological performance in the processing line in order to create a better product that is safe and promotes consumer confidence.

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