BACTERIOLOGICAL SURVEY OF AFD (MEAT) PACKING PLANT

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The paper describes the manufacturing process of freeze dried mutton from slaughtering to packing and makes an assessment of microbial build-up on equipment, hands of workers and environment in which the mutton comes in contact during processing.

A study was made of the microbial contamination of environments in which the carcasses/meat of sheep/goats come in contact from the time of slaughter to the final packing stage.

Initial microbial load before the start of day's work was appreciably low. The microbial build-up in the areas and equipments of slaughter hall and deboning hall increased commensurate with the increase in the number of animals slaughtered. There was a sharp rise in the first two hours and a steady increase in the subsequent two hours. High build-up was found on the moving tops of the inspection and bleeding tables, guillotining knives, wooden planks, and band saw table tops. Aerial counts determined at various places showed that the slaughter hall had high microbial counts. The carcass cooling room, the cooked meat cooling room, quick freezers and freeze drying cabinets were almost free of contamination. In packing room very slight build-up was observed as the work progressed.

With effective sanitization it is possible to obtain considerably low counts. Studies have been undertaken to evolve highly efficient hygienic control measures for keeping equipment and environment free of contamination.

In a commercial meat processing unit, where number of men, material and equipments are involved the hygienic condition of the processing area plays a vital role in the quality of the finished product and assessment of shelf life.

Several authors [1–6] have discussed the potential sources of microbial contamination in the slaughter hall and retailing units. Various sanitizing methods for meat packing plant have been recommended [7–8].

The Department of Defence Production (India) has installed an AFD Unit for the manufacture of precooked dehydrated mutton from live animals. It is set up on the most modern lines. At present approximately 800 animals (sheep/goats) are slaughtered daily. The microbial status of freeze dried mutton during the various stages of processing and the quality of finished product have been communicated [9–10]. It was considered desirable to study the microbial status of environments and equipments with which the meat comes in contact during slaughter, processing and packing so that hygienic control measures are adopted and the quality of freeze dried mutton is maintained.

MANUFACTURING PROCESS

Animals are accepted as per ASC Specifications. These are segregated for about 16 hours, only drinking water is made available during this period. The animals are first stunned, guillotined, and then beheaded carcass is placed on a moving top (rubber) bleeding table. The speed is so regulated (17 animals/5 minutes) that the animal bleeds out completely as it reaches the other end where it is hooked on to a moving overhead conveyor. Flaying and evisceration is carried out on these overhead conveyors.

The viscera and plucks are kept on a moving top (stainless steel) inspection table, provided with compartments. The dressed carcass on the conveyor and its viscera and plucks on the inspection table move at the same speed so as to facilitate post-mortem inspection. The carcasses are washed after (*i*) flaying, (*ii*) evisceration and finally jet washed at a pressure of 100 lbs/inch^2. The dressed carcasses are stored for 24 hours at 5°C for setting. The set carcasses are sawed into wholesale cuts. These cuts are passed on to a moving top (stainless steel) boning table where these are boned manually

The various moving table tops mentioned above get washed with spray of hot water at 50°C. The deboned meat is filled in metallic meat forms and cooked in steam under normal pressure. The subsequent operations are cooling, slicing, deep freezing, freeze drying, and packing in cans under nitrogen.

Cleaning of Processing Area and Equipments

The processing areas and equipments are kept clean during the working hours and are washed thoroughly after completion of day's work. The equipments are washed repeatedly with water and steam. The wooden planks are also washed in the same way and salted. The slicing machine is washed with detergents and steamed. The floor area is scrubbed and washed in sequence with (*i*) water, (*ii*) solution of bleaching powder and caustic soda, (*iii*) hot water and occasionally with phenyl.

MATERIALS AND METHODS

The bacteriological status of processing area which included slaughter hall, deboning hall, cooking cooling, slicing, and packing rooms was determined.

Sampling sites (Table 1) were so selected as to typically represent the extent and sources of microbial contamination at different stages of processing i.e., wherever carcass, meat. comes in contact. Samples were taken from guillotining knives; table tops used for bleeding, inspection and deboning/wooden planks; knives; hands of workers engaged in skinning, deboning, slicing and packing of meat; band saw used for making wholesale cuts; meat cooking forms; slicing machine; trays and packing cans.

Aerial counts were determined in the slaughter hall (28–30°C), deboning hall (26–28°C), carcass cooling room (5°C), cooked meat cooling room (5°C), quick freezers (—30°C), freeze drying cabinets and packing room (27°C) (see Table 2). Samples were drawn three times at two-hour intervals.

TABLE 1

BACTERIAL COUNTS OF PROCESSING AREA AT DIFFERENT PERIODS

Processing area		Bacterial counts per square centimetre		
		0 hr	after 2 hr	after 4 hr
Slaughter Hall	Guillotining knife	5×10^2	$8\cdot8\times10^4$	$1\cdot6\times10^5$
	Moving top bleeding table	5×10^2	$2\cdot1\times10^4$	$2\cdot7\times10^5$
	Hands of skinning workers	5×10^2	$6\cdot26\times10^4$	$7\cdot5\times10^4$
	Moving top inspection table	$5\cdot8\times10^2$	$3\cdot28\times10^4$	$4\cdot5\times10^5$
	Knives of workers	$3\cdot7\times10^2$	$7\cdot3\times10^4$	9×10^4
Deboning Hall	Band saw	1×10^2	1×10^4	$1\cdot5\times10^5$
	Wooden planks	$7\cdot4\times10^2$	$2\cdot1\times10^5$	$2\cdot16\times10^5$
	Moving top deboning table	1×10^2	$5\cdot7\times10^3$	$1\cdot1\times10^4$
	Hands of workers	$1\cdot6\times10^2$	$1\cdot2\times10^4$	$1\cdot9\times10^4$
	Knives of workers	$1\cdot1\times10^2$	$8\cdot6\times10^3$	$1\cdot06\times10^4$
	Meat cooking forms	78	—	—
Slicing Section	Slicing machine	8	$2\cdot5\times10^3$	—
	Hands of workers	15	$5\cdot9\times10^3$	—
	Meat trays	6	$3\cdot3\times10^2$	—
Packing Section	Packing cans	Nil	—	—
	Trays	Nil		—
	Hands of packers	6	15	22

TABLE 2

CONTAMINATION OF ATMOSPHERE IN SLAUGHTER HALL

Processing area	Aerial counts		
	0 hr	after 2 hr	after 4 hr
*Slaughter hall 28·30°C	50	∞	∞
*Deboning hall 26·28°C	37	78	105
†Carcass cooling room 5°C	2	3	3
†Cooked meat cooling room 5°C	1	2	2
†Quick freezers —30°C	NIL	NIL	NIL
*Freeze drying cabinets	NIL	—	NIL**
*Packing room	3	5	9

†Incubation at 15°C *Incubation at 37°C **After 8 hours

In sampling a sterile cotton swab was moistened in 250 ml erlenmeyer flask containing 100 millilitres of ringer solution. Sterile aluminium templates of 1″ diameter were used in swabbing the area. Approximate dilutions were transferred to petri dishes poured with standard method plate count agar and incubated for 72 hours at 37°C. The bacterial counts were reported as the number of colonies per square centimetre of the surface area.

Aerial counts were determined by exposing 80 mm diameter petri dishes poured with standard methods plate count agar at various locations (Table 2) for five minutes at two-hour interval. The aerial counts were reported as the number of colonies per plate after incubation at 37°C and 15°C for 72 hours.

Experiments were carried out from July to September. The temperature was 31° ± 4°C and the humidity was over 70%.

The various operations for dressing eight hundred animals in the slaughter hall require four hours for forty workers. The preparation of deboned meat from these carcasses by thirty men requires 16 hours. The slicing of cooked and cooled meat by two workers requires 7 hours. The packing of total freeze dried meat obtained by 16 workers requires eight hours.

RESULTS AND DISCUSSION

The microbial population of the equipment and hands of workers with which the carcass/meat came in contact during slaughtering, processing, and packing are shown in (Table 1).

In the slaughter hall the carcasses moved at the rate of 200 per hour. The guillotining knife was having an initial bacterial load of 5×10^2 which increased to $8{\cdot}8\times10^4$ after two hours and to $1{\cdot}6\times10^5$ after four hours. The guillotining knife came in contact with the skin of every animal slaughtered and blood stains stuck on it. The bacterial load of the bleeding table was higher than that of the guillotining knife. About seventeen carcasses were placed lengthwise and each remained for a period of 5 minutes. The total contact period of skin at any place on the surface of the bleeding table was two hours for the entire slaughter of 800 animals.

Skin and occasional blood drops, which got stuck to the hairs of the skin, contributed to the high build up on the bleeding table. Empey & Scott[3] in their studies encountered 100,000 to 31 million bacteria growing aerobically per cm^2 on the surface of the unwashed hides of the cattle.

The build-up on the knives and hands of the skinning workers is also due to the skin and the fisting action used in skinning. The highest microbial load of $4{\cdot}5\times10^5$ was recorded on the inspection table, where the viscera and plucks are kept for post-mortem inspection. Gutierrez[11] found an average of 1·3 million organisms per millilitre of intestinal content.

In the slaughter hall the contamination is in the decreasing order : (*i*) inspection table, (*ii*) bleeding table, (*iii*) guillotining knife, and (*iv*) knives and hands of workers. The different areas in the slaughter hall floor were also evaluated for microbial build-up during operation period for the same time interval viz, 0 hr, 2 hr, and 4 hr. The figures obtained were $1{\cdot}1\times10^5$, $3{\cdot}9\times10^5$ and $4{\cdot}7\times10^5$ respectively. The high contamination of the floor may be due to mobility of personnel equipments, and wet and rough surface of the floor. The microbial status of the dressed carcasses was found to be of the order of 2000/cm^2. The ow counts of the dressed carcasses were due to the fact that (*i*) the carcasses were spray-washed after

removal of the skin, (*ii*) the dressed carcasses moved on to the overhead conveyors, and (*iii*) after post-mortem inspection, they were spray-washed and then finally jet-washed at a pressure of 100-150 lbs/inch^2.

In the boning hall the speed of cutting the carcasses into deboned meat was 50 per hr. The microbial build-up observed on the band saw table used for wholesale outs is $1 \cdot 5 \times 10^5$. All the cuts slided through this place as these are passed on to the deboning table. The meat particles and their semears were noticed at times on it. A microbial build-up upto 2×10^4 /cm^2 was recorded on deboning table, knives and hands of workers.

The highest build-up noticed on the wooden planks used for deboning of ribs was of the order of $2 \cdot 16 \times 10^5$. This was due to sticking of meat particles on their cuts and rough surfaces. The high microbial population present after two hours of work on the band saw table, boning table, and wooden planks could transfer appreciable amount of bacterial contamination to the deboned meat. The microbial counts on the deboned meat were about 10,000/g. The deboned meat was filled in the cooking forms and cooked in steam, which minimised the microbial load. It was then cooled, pressed into blocks and sliced. Maximum precaution was required after the cooking stage to keep the microbial counts to the minimum.

In the slicing machine cooked meat of 115 carcasses could be sliced in one hour. The microbial load observed after two hours of work on the slicing machine was $2 \cdot 5 \times 10^3$. When about 415 kg of cooled meat would have been sliced. There is also a change in the temperature of meat from 5°C to the room temperature of 25°C. The build-up on the meat slicers is 1000/g. Sliced meat pieces were kept in the trays and steamed for a short period before keeping in the quick freezers for four hours. These were subsequently freeze dried and packed in sterilized cans. Strict hygienic conditions were maintained in the packing section. The packers washed their hands frequently with sanitizing agents. The finished product had a total microbial count less than 1000/g.

Air counts determined are shown in Table 2. The atmosphere in the slaughter hall was found contaminated due to the various operations viz, guillotining, skinning, evisceration, temperature and humidity

In deboning hall, where raw meat was handled, the counts are appreciably low. Very low counts were observed in (*i*) carcass cooling room, (*ii*) cooked meat cooling rooms, (*iii*) quick freezers and freeze drying cabinets, and (*iv*) packing room, because strict hygienic conditions were maintained at these places.

The microbial load assessed in the slaughter hall, deboning hall and on equipment was expected to be high considering the number of animals slaughtered each day and the traffic of men, material and mobile equipments involved. With effective sanitization of equipments, moving top tables etc considerably lower counts could be obtained. Even on equipment like wooden planks very low counts of microbial load could be obtained although the sanitization process involved was comparatively laborious.

Studies on these aspects will be initiated and reported. The finished AFD meat is regularly examined for microbial analysis. The finished product has microbial counts within 2000/g as against Common Wealth Specifications of 20,000/g for identical materials. E. Coli, Staphylococci, and Streptococci were never observed.

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