Meat microbiology, food safety and Quality assurance

Studies on the Effect of Chemical Sprays on meat Quality and Shelf Life of Fresh Goat meat

U.K Pal and Dr. V. N. Bachhil
M. V. Sc. Thesis, May-1987 **Chairman**

Thirty samples from five young and healthy goat carcass of either sex were subjected to microbiological, physic-chemical, organoleptic and sensory evaluation during storage at ambient and refrigeration temperatures.

Acetic acid, Lactic acid, Citric acid, ascorbic acid and potassium sorbate were used in the form of sprays in two different combinations. Solution no:1 contained 2.0%, 1.0%, 0.25%, 0.10% and 4.0% and solution no:2 contained 1.50%, 0.75%, 0.15% and 0.075% and 2.0% acetic, lactic, citric and ascorbic acids and potassium sorbate respectively. The solutions were made up-to 100% by distilled water. The solutions were sprayed @ 25 ml per kg. On goat meat and stored at ambient and refrigeration temperatures. They were analyzed at 0,6th, 24th and 48th hr. of storage at ambient temperature and 0, 3rd, 6rd, 9rd, and 12th day of storage under refrigeration. Life of treated samples was found to be 24hr, which is nearly 6 hr. more than the untreated samples.

Under refrigerated storage, the untreated samples were observed to be of poor quality having a mean organoleptic score of 2.44 on 6th day of storage with mean oraganoleptic scores of 3.22 and 3.0 solution 1 and 2 respectively. The microbial and other qualities of the treated samples indicating an increase in shelf life at refrigerator temperature. From the above mentioned findings it can be concluded that both the sprays used in this experiment increased the shelf life of goat meat at both the storage temperatures without affecting the meat quality.

Effect of EDTA and Ascorbic acid on Storage Stability of Goat and Buffalo Meat.

Uday Saha Dr. T. R. K. Murthy

M. V. Sc. Thesis, Spet.-1992 **Chairman**

The refrigerated shelf life of meat is limited and even pathogens grow at these temperatures. Further treatment of meat is necessary, even after maintaining strict hygienic measures, to reduce the contamination and extend its shelf life. For prolonging the shelf life of meat, the ideal treatment, should not only reduce the contamination but also limit color changes and lipid oxidation. In the present investigation, ethylene di-amine tetra acetic acid (EDTA) and ascorbic acid was used as a chemical dip for extension of shelf life of goat and buffalo meat at refrigeration temperature.

Investigations were carried out on goat and buffalo meats by using the following dip treatments – (I) 1% EDTA, pH 5.8-6.1; (II) 1% EDTA + 1% Ascorbic acid (E+A), pH3.8-4.1 and (III) 1% EDTA +2% Sorbitol (E+S), pH 6.12. The untreated meat served as control. The samples were analyzed at different intervals of refrigerated storage for microbial (APC, PPC, coliforms, coliforms after resuscitation, Entrobacteriaaceae, Entrobacteriaceae after resuscitation, Staphylococcus, aureus, Pseudomonas, Lactobacillus, yeast and mould physic-chemical (pH, ERV, TBA, total pigments and met-myoglobin) and sensory (color, odour and overall acceptability) evaluation. The efficacy of the chemical dip treatment was also studied on Salmonella Contaminated meat.

In conclusion, it has been demonstrated on the basis of microbial counts, physic-chemical and sensory evaluation of goat and buffalo meat that treatment with EDTA and ascorbic acid has prolonged the shelf life of fresh meat by preventing or reducing the growth of spoilage and pathogenic organisms, especially at lower level of contamination. It can also be observed that by raising load is reduced significantly without much affecting the sensory qualities of meat throughout the period of refrigerated storage.

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Effect of Buffered Lactic acid on Microbial Quality of Goat and Buffalo Meat during Refrigerated storage.

G. Ravindranath and Dr. T. R. K. Murthy

M. V. Sc. Thesis, Oct.-199 **Chairman**

The present investigation was undertaken to study the effect of increased concentrations of Lactic Acid (LA) in LA buffer (pH 3.0) on pH, microbial sensory evaluation of goat and buffalo meats during refrigerated storage. LA concentrations varying from 5 to 20 % in LA buffers was compared with 2% LA on refrigerated shelf life of goat and buffalo meats and also in meat inoculated with spoilage or pathogenic organisms.

Preliminary investigations revealed that increased concentrations of LA caused increased reduction in pH of goat and buffalo meat but colour was adversely affected at concentrations above 10% LA> The 10% LA psychrotrophic plate counts, counts of Pseudomonas, Enterobacteriaceae and coliforms compared to control and 2% LA and 5% LA buffer treatments. No off-odours were detected up-to 10^{th} day in treated samples of goat meat whereas control showed off-odours on 10^{th} day. In buffalo meat, no off odours were detected up-to 8^{th} day in 5% and 10% LA buffer treated sample whereas 2% LA treated sample and control showed off odours on 8^{th} and 4^{th} day respectively. Experimental inoculation with pure cultures of Pseudomonasfluoroscens, Pseudomonasfragi, E.coli and S. aureus showed reduction after LA treatments.

Development of a Shelf Stable Intermediate Moisture Product from Goat Meat.

Atin De and Dr. T. R. K. Murthy

M.V. Sc. Thesis, Sept-1997 **Chairman**

Meat products, which need no refrigeration facilities during storage, are important for developing countries. We cured goat meat along with humectants in a series of the experiments and evaluated for colour, odour, sweetness and acceptability. On the basis of the preliminary experiments, it is proposed to cure meat chunks at 4^0C for 48 hrs. The curing solution had the following composition; salt 8%, polyphosphate 0.25%, sodium ascorbate 0.05% sodium nitrite 0.02%, potassium sorbate 0.30%, glycerol 10%, sorbitol 4% and propylene glycol 3%. The solution was drained and the meat chunks were smoked at relative humidity of 60% to an internal temperature of 77^0C in a smoke oven. The product was vacuum packed in Nylon-CPP bags and stored at room temperature for 45 days. The product was rehydrated at 121^0C for 20 minutes (1 part meat to 3 parts water) before consumption.

The intermediate moisture goat meat prepared from above has a moisture content of 39.07% and water activity of 0.87. The aerobic plate counts, psychrotrophic plate counts, micrococcal counts, staphylococcal and faecal streptococcal counts were nearly 2logs/g after 45 days of storage at room temperature. Tyrosine value, free amino acids content, titratable acidity and water activity increased while moisture content, residual nitrite content, pH, TBARS value decreased on storage up-to 45 days at room temperature. The product was acceptable up-to a storage period of 45 days at room temperature.

Application of Hurdle Technology for the Development of Shelf Stable Keema

J. Karthikeyan and Dr. Sushil Kumar

M. V. Sc Thesis, Aug. 1997 **Chairman**

Meat based fast food industries are producing traditional meat products. 'Keema', producing traditional meat product of India, is a highly perishable primary due to microbial spoilage. The present study was aimed to extend the shelf life with optimum combinations of hurdles and to assess its quality during ambient and refrigerated storage.

Lactic acid, a preferred acidulant, was added at calculated amount to produce keema at pH 5.80 rated better by taste panelists. Minced goat meat with added humectants, preservatives, spice mix and calculated amount of lactic acid was fried to produce keema with 0.90 and 0.88 a_w where keema with a_w 0.90 was preferred. The hurdle treated keema stored at ambient (35+1.^{0}C) temperature showed a gradual increase in pH, moisture content, water activity, TBARS number, tyrosine value with reduced aerobic, anaerobic and staphylococcal counts than untreated ones. As the storage period increased, all the sensory qualities for both untreated was well accepted up-to 3rd day while the untreated was accepted only on first day

During refrigerated storage, relative decrease in TBARS number, tyrosine value, moisture increment and consequent increase in a_w and decrease in aerobic, anaerobic, psychrotrophic and staphylococcal count than ambient temperature was observed and the treated keema was well accepted up-to 18 days whereas the untreated was good up-to 6 days. The study indicated that the shelf life of keema can be extended through application of hurdle technology.

Studies on Keeping Quality and Spoilage Pattern of Buffalo Meat.

M. K. Agnihotri Dr. H. B. Joshi

Ph.D. Thesis, July, 1988 **Chairman**

Studied the changes that occur in fresh buffalo meat to prevent spoilage during storage at low temperatures for reducing economic losses and help in maintaining the wholesomeness. Meat samples from Murrah Buffalo were evaluated to find the changes in physical (pH and moisture content), physic-chemical (ERV), chemical (TBA, FFA, TVN content, tyrosine value, sacroplasmic and myofibrillar protein components), microbiological (SPC, psychrotrophs, proteolytic counts, Gram negative counts and total coliforms) and sensory attributes in meat during refrigerated storage (5±1˚C) for periods of 0 (2.5 to 3.0hrs. post-slaughter), 3, 6 and 9 days. To compare the degree of changes that occur in meat due to microbial activity, antibiotics treated meat was also analyzed simultaneously for above parameters during storage which served as autolysis control.

Initial pH which varied from 5.66 to 6.20 with a mean of 6.05±0.10 ERV value ranged 19.00 to 47.00 ml (29.10 + 4.82ml) after 2.5 to 3.0hrs. Post-salughter. Total voltaic nitrogen (ammonia) content (TVN) which was measured to assess mainly the amino acids degradation during storage, ranged from 7.36 to 13.06 mg N with a mean value of 9.42±0.99 mg N/100ml meat juice in fresh meat samples after 2.5 to 3.00hrs. post-slaughter. Initial values of tyrosine in fresh meat samples ranged from 0.0331 to 0.430 mg/g meat. Standard plate counts (SPC) on 0 day ranged from log 4.13 to 5.53/g meat and were significantly higher ($P<0.01$) in untreated sample than in antibiotics treated control during storage. Psychrotrophs counts varied from log 3.32 to 4.55/g meat on 0 day. Proteolytic bacterial counts ranged from log 3.08 to 4.70/g meat, on 0 day. Lipolytic bacterial counts initially ranged from log 3.25 to 4.52/g meat. Gram negative counts ranged significantly higher ($P<0.01$) in untreated sample than in antibiotics treated control during storage. MPN of coliforms counts on 0 day ranged from log 1.30 to 2.66/g meat.

Hygienically produced buffalo meat could safely be preserved for 9 days at 51C without any significant changes in quality. Most of the chemical changes which occurred during refrigerated storage were mainly due to intrinsic inherent tissue enzymes activities. Among all rapid tests studied none were found suitable to assess the degree of spoilage of meat. Meat samples obtained aseptically and treated with oxytetracycline + mycostatin could serve as a suitable autolysis control. Significant changes in organoleptic properties might occur only after the standard plate counts exceed a level of log 7.00/g meat under present procedures of production.

Studies on Spoilage Micro-organisms and pathogens from Meat of Different Animal Spices and the Effect of Lactic acid Bacteria on their Growth.

T. R. K. Murthy and Dr. C. Natrajan
Ph.D. Thesis, Dec. 1988 **Chairman**

Growth of bacteria on meat results in spoilage and poisoning. The present study envisaged an ecological approach, in place of chemical preservatives and antibiotics by employing lactic cultures as biological agents to restrain the growth of spoilage and pathogenic organisms in meat.

After assessing the levels of contamination, minced goat was treated with lactic cultures including *Streptococus*lactic, *Lactobacillusbulgarichs* or *Lactobacillusplanataram* and evaluated for mesophilic and psychrotrophic contamination, pH, total acidity, colour, odour and overall acceptability at different storage intervals generally up-to 10 days. Experiments were conducted to compare the influence of single and combinations of lactic cultures on microbial and sensory evaluation of minced meats from goat, buffalo and poultry at different storage intervals. The lactic cultures were also tested for their effectiveness in inhibiting the growth of pure cultures of each of the spoilage or pathogenic organisms tested, viz. *Psedomonasfragi*,*Escherichiacoli*, *Staphylococcusaureus* and *Salmonellaanatam* in a meat system.

Lactic acid bacteria both as single and mixed cultures significantly reduced microbial counts of minced meats during refrigerated storage. Anti-microbial effect of lactic cultures were improved when mixtures of the cultures were used on 8^{th} day of storage. Lactic cultures also inhibited spoilage and pathogenic organism in autoclaved meat slurry. It has been demonstrated on the basis of microbial counts and sensory evaluation that treatment of meat with lactic cultures and their mixtures has a salutary effect on prolonging its shelf-life by preventing or reducing the growth of spoilage and pathogenic organisms, especially, at lower initial levels of contamination.

Studies on bacterial profile of goat , pig and poultry meat and its public health significance

Himanshu Kumar and Basanti Bist
M.Sc: Thesis, 2003 Chairman

A total number of 123 samples comprising of 25 each from chevon pork and poultry meat, 24 from butcher' knife each were processed assess the bacteriological status of above mentioned samples. Quantitative examination of samples was performed by SPC, Colifrom count; Staphylococcus count and MPN while qualitative examination by isolation of bacterial pathogens. For chevon, pork and poultry SPC (cfu/gm) was 7.8, 8.1 and 6.9 while colifrom count (cfu/gm) was 4.24, 4.34 and 4.1 respectively. For chevon, pork and poultry the mean value for staphylococcus count (cfu/gm) was 5.7, 5.6 and 4.9 while MPN/gm was recorded as 7.3, 6.8 and 6.5 respectively. In this study highest contamination of SPC was found for pork and chevon was most contaminated for staphylococcus followed by pork and poultry meat. The MPN values for chevon were recorded highest and lowest for poultry meat. In the qualitative examination 180 isolates of bacteria were procured from 123 meat and swabs samples out of which E.coli (40), staph spp (31), Salmonella spp (20), Klebsiellla spp (23), Bacillus cereus 14, Corynebacterium spp 6, streptococcus 27, proteus vulgaris 11, and pseudomonas aeruginosa 8 were found. A total 112 isolates were subjected to antibiogram, higher range of sensitive were recorded for ciprofloxacin (100%), pefloxacin (100%), Gentamycin (80%), chloramphenicol (71.4%), Amoxicillin (67.8%), tetracycline (60.7%), streptomycin (58%) and Kanamicin (53.2%).

Seroprevalence of brucellosis in cattle and buffaloes in certain areas of Gorakhpur district ant its public health significance

Vikas Kumar and Basanti Bist
M.Sc:Thesis, 2004 Chairman

Blood serum samples were collected from 579 cattle, 407 buffaloes and 210 human beings and serologically tested using RBPT, SAT and Indirect ELISA. These tests were very effective in accurate diagnosis in brucellosis. Over all Seroprevalence of brucellosis in cattle and buffaloes in 17 areas of Gorakhpur was 1.72% and 1.11% animals were doubtful reactors. Out of 210 human sers samples only one human serum sample for brucella antibody (0.48%) and one serum gave doubtful reaction (0.48%0. Overall Seroprevalence of Brucellosis in cattle was 1.55% (9/579) in 17areas of Gorakhpur in UP and 1.03 animals were doubtful reactors (6/579). In Buffaloes, Seroprevalence was recorded as 1.96% (8/407) and h=buffaloes were doubtful reactors. 14 strains of bacteria were isolates from vaginal swabs of cattle and buffaloes. The isolates were identified aon the basis of cultural microscopic and biochemical reactions. These strains were identified as Brucella abortus (2), Staphylococcus aureus (5), Corynebacterium pyogenes (2), Listeria monocytogenes (2), E.coli (2), and Nessesia gonorrhoeae (1). The isolates were highly sensitive to ciprofloxacin, norfloxacin, tetracycline and streptomycin antibiotics. These may be given as drug of choice for genital tract infections of cattle and buffaloes.

Comparison of ELISA and PCR vis-a-vis culture methods for detecting Aeromonas spp in foods of animal origin

Sushrut Arora and Basanthi Bist
M.SC: Thesis, 2004 Chairman

Aeromonds are facultive anaerobic, Gram-nagative bacilli residing in family Aeromonadaceae. These are ubiquitous organisms found in aquatic environments; soil; food items, including meat products, fish, eggs, milk products and vegetables; and animal and human faeces. Conventional cultural methods to isolate and identify aeromonads have proved to be time and labour intensive. These facts and the increased interest of workers all around the world In this emerging pathogens has led to the development of newer methodologies for its efficient and rapid detection. Out of a total 50 milk samples screen for the presence of Aeromonas by the three methods vis. Indirect ELISA, duplex PCR and cultural method only 1 (2.00%) were found positive by all the three methods. Similarly 50 samples of chicken were tested by all three methods. Three samples turned out to be positive. Thus all the three methods compared in the study showed a good correlation amongst them in detecting naturally contaminated food samples.

Studies of Bacterial profile of goat meat and its public health significance

Vijay Kumar Bhasker and Basanthi Bist
M.Sc: Thesis, 2005 Chairman

A total of 123 samples comprising 75 goat meat, 24 butcher's hands and 24 butchers knife were processed for bacteriological analysis from retail outlets of Mathura. Quantitative examination was performed by Standard Plate Count, Coliform Count and Staphylococcus Count and Qualitative examination by isolation of bacterial pathogens. The mean value of standard plate count for chevon, butcher hands and butchers knife was 7.841, 7.814 and 7.829 respectively. The mean value of coliform count for chevon, butcher hands and butcher knife was 4.313, 4.32 and 4.27 respectively. The mean value of Staphylococcus count was recorded as 2.481, 2.756 and 2.751 for chevon, meat butchers hand and butchers knife respectively. A total 212 isolates of bacteria were procured from 75 meat samples and swabs. The percent isolation of pathogens was E.coli 16.98 (36/212), salmonella spp. 5.66 (121/212), Staphylococcus aureus 20.28 (43/212), Klebisella spp 9.91 (21/212), pyogenes 4.72 (10/212) and unidentified cocci 7.55 (16/212) unidentified rods 8.49 (18/212).

Studies on bacterial contamination of fish meat with special reference to Salmonella and E. coli and public health significance

L.N. Gupta and Basanthi Bist
M.Sc: Thesis, 2005 Chairman

A total of 110 fish meat samples were collected from different localities of Mathura city. The samples were analyzed for bacterial load by Standard Plate Count, Coliform count, and Staphylococcus count for Quantitative examination and for qualitative examination only E.coli and Salmonella organism were isolated. The mean value SPC, Colifrom count and Staphylococcus count from fish meat were 7.99, 4.46 respectively. A total 11 isolates of E.coli and % isolates of salmonella from fish meat samples were isolated. The serotype of salmonella belongs to S.Typhimurium (1) and S.Heideiberg. E.Coli isolates show higher range of sensitivity to ciprofloxacin, Ampicillin, Norfloxacin, Gentamycin, and Erythromycin and whereas Salmonella isolates were highly sensitive to Ciprofloxacin, Erythromycin and Ampcillin.

Bacterial contamination in meat of poultry and eggs with special reference to E. Coli Salmonella species and its public health significance

Vinod kumar Yadav and Basanthi Bist
M.Sc: Thesis, 2006 Chairman

In the present study a total no. Of 380 samples comprising of 120 meat samples, 200 egg samples and 30 swabs samples each from butchers hands and knife were taken to assess the bacterial load of poultry meat and egg. In the quantitative examination of samples, the mean value of SPC (cfu/gm) for meat was recorded as 6.092, For egg surface 7.6413 and for egg yolk 6.5505 respectively. Coliformcount for meat samples (102) was recorded as 5.2469 while staphylococcus count recorded as 5.60. From the n=380 samples total of 24 salmonella spp and 60 E.coli were isolated. The prevalence of salmonella and E.coli were reported as 10.9% and 26.17% respectively. A total of 32 E.coli and 14 salmonella isolates were subjected to antibiogram. The isolates showing higher range of sensitivity for salmonella were recorded as ciprofloxacin, Norfloxacin and streptomycin while for E.coli by amoxicillin and streptomycin.

Sero-prevalence of brucellosis in cattle and buffaloes in certain organized dairy farm and rural areas of Uttar Pradesh state and its public health significance

Vijay Kumar Rathore and Basanthi Bist
M.sc: Thesis, 2006 Chairman

In this Study a total number of 342 cattle, 626 buffaloes, and 40 human samples were tested by STAT and RBPT for detection of brucellosis in the different areas of UP state. In the Agra district total 8.62% (20/232), cows 8.8% (11/125) and Buffaloes 8.41% (9/107) found to be positive. In the DDD dairy farm total 11.5% (23/200) out of which cows 13.75% (22/160) and buffaloes 2.5% (1/40) found to be positive, while in the rural areas 2.12% (1/47) buffaloes found positive for brucellosis in the Mathura district. In district Lakhimpur Khiri all 200 buffalo's sera samples were negative and in Dist. Bulandshahar 12.24% (6/49) sera samples were found doubtful for brucellosis. In the Dist. Aligarh total 8.33% (5/60) buffaloes were positive while 6.66% (4/60) were doubtful. In the Etah Dist. Total 8.33% (15/180) out of which 1.7% (1/57) cattle and 11.38% (14/123) buffaloes found positive in the same district 35% (7/20) cattle and 65% (13/20) buffaloes were found doubtful for brucellosis with the history of abortion and infertility. In the present study 2.5% (1/40) human sera samples found positive for brucellosis.

Studies on prevalence of Echinococosis in buffaloes and goat

VipinKumarGupta and Basanti Bist
M.Sc: Thesis, 2007 Chairman

The study was initiated in view of the zoonotic effect and economic losses of hydadidosis in ruminants of Mathura and Agra regions. An overall prevalence of hydadiosis in sheep, goat, and buffaloes was observed as 4.52%, 2.78% and 9.87% respectively. The infection rate of hydadidosis in rams and ewes was recorded as 4.34% and 6.25% respectively while the infections rate of hydadidosis in bucks and does was 1.26% and 6.81% respectively. The adult sheep above one year had the incidence as 5.13% and in lambs it was 10.71% and 12.29%, respectively. The adult sheep above one year had the incidence as 5.13% and in lambs it was 2.63%, while the adult goats had 3.25% and kids had 1.75%. The present investigation indicated that the most common site of infection was the lungs. In sheep 57.14% of lungs, 42.85% of liver were found to be affected with hydatid cyst. The infection in goats were found to be 80.00% and 20.00% in lungs and liver, respectively and for buffaloes 78.15% and 21.87% lung and liver were infected, respectively.

Prevalence of *Clostridium perfringenes* in foods of Braj region

Ankur Priyadarshi and Basanti Bist
M.Sc: Thesis, 2010 Chairman

A total of samples comprising 60 chicken meat, 60 buffalo meat, 60 pig meat, 50 fish meat, 20 cooked chickens meat, 20 badam-milk and 20 ice-creams were collected in and around the Mathura city and analyzed for the level of contamination of Clostidium perfringenes. The overall occurrence of Clostridium perfrigenes was 48.57% in different food with highest prevalence in poultry (66.67%) followed by Buffalo (61.67%), fish (60%), pig (53.33%) and goat (48.33%). The meat samples of cooked chicken had 10% of *Clostridium perfringenes*. In the milk products samples, badam-milk and ice-cream had no *Clostridium perfringenes* reported. The presence of *Clostridium perfringenes* in meat samples showed the in adequate sanitary and hygienic condition in and around the products leading to cross contamination of samples. CMM showed higher level of the *Clostridium perfringenes* during enrichment than other two media (IMM and ATM). A total of 102 isolates of *Clostridium perfringenes* were screened to observe lecithinase activity, out of which 91(89.2%) were reported to be positive. In meat samples, poultry (95%), goat (90%), buffalo (90%), pig(85%) and fish (85%) isolates showed lecithinase activity. In cooked meat isolates, 100% lecithinase activity was displayed. For haemolytic activity, 77 strains of *Clostridium perfringenes* were observed, 65 strains (84.42%) had shown hemolysis on blood agar plates. The haemolytic activity of the isolates of *Clostridium perfringenes* of goat (93.33%), pig (86.67%), poultry (86.67%), fish (80%), and buffalo (73.33%) were found. In cooked chicken haemolytic activity was observed to be 100%. Total 25 Raw meat samples isolates and 2 cooked meat samples isolates were screened by PCR to detect the presence of alpha toxin (cpa) and enterotoxin gene (cpe) in *Clostridium perfringenes* strains. The samples of buffalo meat strains (80%) followed by fish (60%), poultry (60%) pig (60%), and goat (40%), had alpha toxin (cpa) gene of *Clostridium perfringenes*. The two cooked meat samples showed 100% alpha toxin (cpa) gene. None of the samples found to be positive for entrotoxin gene (cpe) among the samples tested. The antibiotic sensitive / resistant pattern of *Clostridium perfringenes* against 16 antibiotics revealed that Piperacillin, Chloramphenicol, Ceftriaxone, and Amikacin were highly sensitive (80-100%), followed by Cephoxitim, Cepharadine, Cefurooxime sensitive (50-70%). Gentamycin found to be resistant around 46%. The drugs like Pencillin G, Tetracyline, Erythromycin and Amplicillin had displayed resistance between (50-70%), while the drugs like Lincomycin, Co-trimoxazole, Cloaxacilllin and Ceftazidime showed resistance from 80 to 95%.

Prevalence of Bacillus Cereus in different foods of Mathura and Vrindavan and its antibiogram studies

SoniaGupta and Basanti Bist
M.Sc: Thesis, 2010 Chairman

The 205 samples of food and food products from local and standard shops Mathura and Vinrindavan region were tested out of which 71 samples revealed contamination with Bacillus cereus and the percent positivity was 34.63%. Higher percent of contamination was found in local shops 39.39% then in standard shops 26.47%. However, statistical analysis revealed that the result was not significant. Sensitivity pattern of 70 islates against 12 antibiotics from food and food products were seen. The all isolates were found sensitive to ciprofloxacin, chloramphenicol, doxycycline and ofloxacin whereas resistant to penicillin and ampicillin. Isolates presented 100%sensitvity to ciprofloxacin ciprofloxacin, chloramphenicol, doxycycline and ofloxacin but the sensitivity was only 97.1, 94.2, 82.2, 74.2, and 57.1% for norofloxacin, gentamycin, amikacin, streptomycin and tetracycline respectively.

Prevalence of verotoxic Escherichia coli in meat, Meat products and water from different sources in certain areas of Uttar Pradesh

SeemaSingh and Basanti Bist
M.Sc: Thesis, 2011 Chairman

The objective of this study was to determine the prevalence of Verotoxic Escherichia coli (VTEC) in meat, meat products and water samples from different sources in certain areas of UP, to characterize them by serological and molecular methods and to investigate for haemolytic activity, Congo red dye binding activity and multiple drug resistance. A total of 372 samples comprising of 192 meat samples (40 carabeef, 30 chevon, 30 mutton, 30 chicken, 32 fish, 30pork), 50 meat products (5 samples each of pork patties, Fish pakoda, ch.curry, ch.patties, ch.nugget, ch. Chat, fried chicken, ch.burger and 10 samples of carabeef kabab)and 130 water (40 Borewell,4o Community supply, 30 River, 20 packed /mineral) samples were collected and screened for the presence of virulence genes stx1 and stx2 by PCR. Overall prevalence of VTEC in meat samples was found to be 18.23%. The highest prevalence of VTEC was detected in mutton (30%) fallowed by carabeef (25%), chevon (20%), chicken (13.33%) and fish (9.38%). The serotypes of VTEC reported in meat samples were O108 (5), O97 (4), 2 strains each of O2, O112, O119, O41, O43. Out of 35 VTEC strains isolated from meat samples 7 strains harboured vt1, while 27harboured vt2, and 1 strain was positive for both the genes. The overall prevalence of VTEC in meat products was recorded as 6%. It is interesting to note that pork patties (2/3) and chicken curry (1/3) was found positive for both VTEC. All the 3 strains of VTEC in meat products carried vt2 gene and belonged to serotype O102. An overall Prevalence of VTEC in water samples was 4.62% (6/130). The highest % positivity of VTEC strains were detected in river water 6.67% (2/30) fallowed by borewell water 5% (2/40) and community supply water 5% (2/40) and they belonged to 3 different serotypes. Serotype O168 (3) was frequently detected fallowed by O102 (2) and O11. Out of 6 VTEC 5 carried vt2 gene and one carried both vt1&vt2 gene. For the study of other virulence marker of VTEC, haemolytic activity and Congo red binding activity were examined. In the present study overall, 77.27% VTEC produced enterohaemolysin on washed sheep blood agar supplemented with 4 were α haemolytic and 6 were non-haemolytic. The positive correlation between VTEC and entrohaemolysin was also observed to be 77.27%, 66.676%, 83.38% for meat, meat products and respectively. Overall 93.18% (41/44) VTEC strains were positive for congored binding activity. The VTEC islates were tested for 20 antimicrobial agents, VTEC srains exhibited highest sensitivity to Norfloxacin (93.18%) fallowed by ofloxacin (90.19%), Chloramphenicol (88.64%), ciprofloxacin (88.64%), Gentamycin (86.36%). The VTEC islates were 100% resistance to novobiocin, pencillin G, fusidic acid, Ticracillin, Methicillin.

Evaluation of Bacterial Quality and Isolation of Escherichia coli (O157:H7) from different meat samples procured from retail meat shops and local slaughter houses of Agra Region

V.K. Singh and Udit Jain
M.Sc: Thesis, 2012 Chairman

A total 120 meat samples, 30 Each from cara beef, chevon, pork and poultry evaluated for bacterial load i.e. Standard plate count (SPC), Colifrom count (CC) and Staphylococcal count (SC) and 240 meat samples comprising 60 each of cara beef, chevon, pork and poultry were evaluated for presence of Escherichia coli (O157 H7). Mewan values of SPC (log_{10}cfu/g) were found to be 7.03±0.07 for cara beef, 6.96±0.78 for pork and 6.75±0.04 for poultry meat. Mean values of Colifrom count (CC) (log_{10}cfu/g) were found to be 3.93±0.14 for chwevon, 3.82±0.12 for poultry, 3.40±0.10 for pork and 3.04±0.08 for cara beef. Mean values Staphylococcus count (SC) (log_{10}cfu/g) were found to be 3.90±0.12 for cara beef, 3.84±0.12 for chevon, 3.35±0.10 for poultry and 2.81±0.11 for pork. Of 74 Escherichia coli (non-)157:H&) isolates 18(30%), 16(25%), 15(26.7%) and 25(41.67%) isolates were obtained from cara beef, chevon, pork and poultry meat respectively. Overall percent prevalence of E.coli (non-O157:H7) in meat samples in different areas of Agara region was found to be 30.83%. Isolation of E.coli from the meat samples is associated with various diseases in man and animals which is of public health significance. The study revealed an urgent need to improve the hygienic condition at all level of production and retailing of meat.

Prevalence of VTEC in faecal samples of diarrhoeic calves, healthy cows and water from certain areas of Agra and Mathura districts

Suman and Basanti Bist
M.Sc: Thesis, 2010 Chairman

The objective of this study was to determine the prevalence of Verotoxigenic Escherichia coli (VTEC) in faeces, water samples in certain areas of, Agra and Mathura districts to characterize them by molecular methods and to investigate haemolytic activity, congo red dye binding ability and multiple drug resistance. A total of 600 faecal samples comprising of 300 from diarrhoeic calves and 300 from healthy cows were collected and processed. A total no. Of 532 E. coli isolates were isolated, of which 250 E. Coli isolates (from 286 samples) were processed for molecular characterization for stx1 and stx2 genes. The overall percent positivity of VTEC in faeces is 15.03% (43/286). Atotal of 150 water samples were collected and processed for molecular characterization for stx1 and stx2 genes. An overall prevalence of VTEC in different sources of water collected from Agra and Mathura districts, was found to be 4.00% (6/150). 22 of 49 (44.89%) VTEC isolates were found positive for haemolysis when tested on sheep blood agar. Among the 49 VTEC isolates were screened for congo red dye binding ability 41 (83.67%) were found positive. Further, the isolates were tested against for 6 antimicrobial agents. VTEC isolates exhibited highest sensitivity to Gentamicin (79.59%) and resistane to Ampcillin (55.10%). In conclusion, the high VTEC prevalence detected in cattle evidences that bovine faeces might play an important role as a contamination source in the Agra Mathura districts. Since VTEC was also detected from water, indicates faecal contamination thus can pose serious threat.

Prevalence of Verotoxic E. Coli in meat products in certain areas of Uttar Pradesh

Tanu Singh and Basanti Bist
M.Sc: Thesis, 2013 Chairman

Present investigation was undertaken to assess the prevalence of verotoxic Escherichia coli (VTEC) in meat and meat products in certain areas of UP. Studies were also carried out to detect virulence markers and virulence genes. A total of 300 samples (135 carabeef, 55 chicken, 25 fish, 60 chevon, 25 pork) and 150 meat products (20 each of mutton Patties, Chicken Patties, Mutton Kabab, Cara beef Kabab, Chicken Nugget, Chiken Burger and 10 each of Chiken Sandwitch , Mutton Curry, FishPakoda) samples were collected and screened for the presence of virulence genes vt1 and vt2 by multiplex PCR. Atotal of 4 (1.33%) meat samples and 1 (0.65) meat product sample were classified as PCR positive. Five isolates (3 from cara beef, 1 from a carabeef kabab and 1 from chevon) were positive for VT genes. All 5 VTEC strains harboured vt2 gene. None of the VTEC isolates contained vt1 gene. All except one VTEC isolate exhibited toxic effects on Vero cells. VTEC strains were examined for additional virulence factors i.e, haemolytic activity and Congo red binding activity. 2 of 5 (40%) VTEC isolates were found positive for haemolysis whwn tested on sheep blood agar. Among the 5 VTEC isolates screened for congo red dye binding ability 4(80%) were found positive. Further, the VTEC isolates were tested for 22antimicrobial agents. VTEC strains exhibited sensitivity to norfloxacin, ciprofloxacin, chloramphenicol, ceftrazone, Amikacin and amoxyclav. The VTEC isolates were 100% resistance to novobiocin, pencillin G, fusidic acid, colistin, tylosin and Methicillin. In conclusion, this study demonstrated that retail meats, mainly carabeef, were contaminated with VTEC strains. The presence of VTEC strains in retail meat is also of concern due to their potential to cause human infections like Haemorrhagic Colitis, Haemolytic Uremic Syndrome and Thrombotic thrombocytopenic purpura.

Epidemiological studies of brucellosis in cattle and buffaloes in Mathura and adjoin areas of Uttar Pradesh and its Zoonotic significance

Pragathi Swarnkar and Basanti Bist
M.Sc: Thesis, 2013 Chairman

The study was conducted to know the seroprevalence of brucellosis in cattle and buffaloes of Mathura and adjoining areas with respect of different epidemiogical determinants and its public health significance by employing I-ELISA, RBPT and STAT and comparison of I-ELISA with the other conventional test. A total of 568 serum samples of cattle and buffaloes of different age, sex and places from organized and unorganized farms of Mathura and adjoining areas were collected, which were screened for Brucella antibodies using RBPT, STAT and indirect ELISA test, where as 108 serum samples of 14 veterinary students and 94 animal handlers were collected from different places of Mathura district. The overall prevalence against brucellosis in cattle and buffaloes were found as 9.3%, 6.61% and 5.10% by I-ELISA, RBPT and STAT, respectively. The overall prevalence of brucellosis in human beings was found as 6.48% and 4.62% by RBPT and STAT, respectively. No Veterinary student was found reactor for brucellosis where as 7.44% and 5.31% animal handlers were found positive by RBPT and STAT< respectively. Considering I-ELISA as a standard test, the sensitivity of RBPT and STAT was found to be of 50% and 33.9%, and specificity was found to be of 98% and 97% respectively. Concordance between RBPT and STAT with respect to I-ELISA was found to be 94% and 92%, respectively. There was moderate agreement between RBPT and STAT with that of I-ELISA. Thus using combination of test for screening of the cattle and Buffaloes against brucellosis were useful rather using a single test.

Isolation and characterization of Verocytotoxic E. Coli in faecal samples, milk, and milk products and animal handlers from certin areas of Mathura and Virindavan region

Charul Rajpoot and Udit Jain
M.Sc: Thesis, 2013 Chairman

A total no. 500 samples comprising of 250 faecal samples (cattle102, buffalo90, calf 38,) 125 raw milk samples, 75 milk products samples (15 each of rasagulla, burfi, peda, paneer and curd) and 50 swabs from hands of animal handlers were collected and assessed for the presence of virulence genes Stx1 and Stx2 by multiplex polymerase Chain Reaction (PCR). Out of 210 E. coli isolates 100 were further processed, Out of these 37 isolates were subjected to verocytotoxic assay and 63 isolates were subjected to PCR. Out of 37 isolates 13 were found to have positive cytopathic effect on vero cell line and 7 E.coli out of 63 were found positive for Stx gene. A total of 109 E.coli isolates (63 faecal samples, 30 milk samples and 16 milk products samples) were screened for the presence of Stx genes. Out of which 9 isolates were found to be positive for Stx genes. Among these isolates of faecal sample of diarrhoeic cow was found positive for Stx1 and one isolate only one isolate from faecal sample of healthy cow, two isolates from faecal samples of diarrhoeic cow, 1 isolate from faecal samples of diarrheic buffalo, two isolate from faecal samples of diarrhoeic calf was found to be positive for Stx2 gene. However, no Stx gene was detected from animal handlers. Prevalence of VTEC was highest in faecal samples followed by milk and milk products. In present study the overall haemolytic activity and congo red dye binding ability of VTEC isolates was found to be 55.5.6% and 88.89% respectively. 5/9 (55.56%) VTEC isolates were found positive for haemolytic activity on sheep blood agar 8/9 (88.89%) VTEC isolates were found positive for congo red dye binding ability. The VTEC isolates were further tested against 13 antimicrobial agents. These VTEC isolates exhibited highest sensitivity to ciprofloxacin (100%), followed by nalidic acid (92.00%), ceftriazone (88.00%), cefotaxime (88.00%) and highest resistance was shown by antibiotics like co-triomoxazole (80.00%), followed by penicillin G (40.00%) and tetracycline (36.00%).

Occurrence of Salmonella organism in foods of animal origin (milk, meat, fish and egg) and water and their public health significance in Mathura district

Rakhi Sharma and Udit Jain
M.Sc: Thesis, 2013 Chairman

Food borne pathogenic zoonotic or potentially zoonotic bacteria in foods of animal orgin (milk, meat, fish and egg) and water are the cause of illness and death for many people. During the study, 370 sample analyzed of different markets of various areas and places of Mathura District as sources of carabeef, chevon chicken, pork and fish meat, samples shown the presence of pathogenic Salmonella species. In carabeef 13.33%, chevon 10%, chicken20%, pork13.33% and fish 0% in meat samples, egg 26.66%, milk8% and in animal products handlers 3.33% occurrence was estimated. In similar way highest contamination of Salmonella species was recorded in chicken meat and least contamination in fish meat. The study also concluded that, the presence of Salmonella in meat samples due to the unhygienic conditions, where and from the meat samples were obtained, either from the pond, lake, river (in case of fish) or from the unhygienic storage and pre-processing and handling conditions (in case of meat and poultry chicken) which makes the food contaminated with pathogenic Salmonella species. Raw milk may act as vehicle for Salmonella infection and can cause serious threat. Milk may get cross contaminated with faecal matter during milking. Majority of the isolates of Salmonella were found to be sensitive to Ceftriaxone, Ciprofloxacin, Gentamicin and Ofloxacin are sensitive to Salmonella spp. Amikacin, Chloramphenicol, Cefoperazone/Sulbactam Kanamycin are intermediaste to Salmonella spp. Ampcillin, Amoxyclav, Cefixime/Clavuanic acid, Tetracycline are resistant to Salmonella spp. Streptomycin are nearly 50% intermediate and 50% resistant to Salmonella Spp according to antibiotic sensitivity pattern.

Detection and identification of *Clostridium perfringenes* in food

Ranvijay singh and Basanti Bist
Ph.D. Thesis Chairman

The presence of *Clostridium perfringenes* was studied in various foods (meat and meat products, milk and milk products, juice and water). The results revealed the overall occurrence of *Clostridium perfringenes* was 57.9% in different food with the highest prevalence in poultry 994.11%). The meat samples of goat and fried chicken had (58%) and (16.66%) of *Clostridium perfringenes*, respectively. Among the milk samples, srikhand (82.1%) had highest presence of *Clostridium perfringenes* followed icecream (44.44%), raw milk (33.3%) and pasteurized milk (32.1%). For the isolation and enumeration of *Clostridium perfringenes*, four different media were used viz. SPS, TSC, SFP and IMM. IMM showed 100% positivity on the basis of presumptive isolation. Among agar media, SFP and TSC had given more than 90% positivity for Clostridum perfringenes followed by SPS (83.66%) in poultry samples. The results of selective media in the goat sample showed TSC and SPS to be better than SFP. In the milk sample particularly pasterurized milk srikhand, SFP was found to be better than SPS in the isolation and identification of *Clostridium perfringenes*. The overall occurrence of *Clostridium perfringenes* in CMM was 88.31% followed by ATM (32.46%) and IMM (22%) in poultry meat in combination with various selective media. In goat meat, CMM showed prevalence of 52.5%, ATM- 22.5% and IMM-20% *Clostridium perfringenes* in combination with selective media. Among virulence markers of *Clostridium perfringenes* were screened to observe leccithinase activity, out which 142 (95.6%) were turned to be positive. In meat samples, goat isolates showed higher lecithinase activity (96.6%) than poultry (92.5%). In milk isolates, lecithinase activity displayed by Clostridium perfringehes was 100%. For haemolytic activity, 139 strains of *Clostridium perfringenes* were observed, 130 (93.52%) had shown hemolysis on blood agar plates. The haemolytic activity in poultry isolates of *Clostridium perfringenes* was 94.54% and found greater than goat (86.66%). In raw and pasteurized milk and icecream haemolytic activity was 100% while in srikhand it was 88.88%. One hundred thirty food samples were screened by PCR by single step enrichment to detect the presence of entrotoxin gene of *Clostridium perfringenes*. Of the 130 samples, 21 (16.15%) samples had enterotoxin gene of Clostridium perfrin genes. Out of 60 samples of poultry, only one sample (1.6%) was positive for entrotoxigenic *Clostridium perfringenes*.

In 30 and 20 samples of goat and srikhand, 8 (26.66%) and 12 (60%) samples were positive for enterotoxigenic *Clostridium perfringenes*, respectively. Raw and pasteurized milk and ice cream didn't show presence of entrotoxin gene among the samples tested. Among the antibiotic tested, Amikacin cephalosporin group (Cefuroxime, Cephradine, Ceftriaxone, Ceftazidime and Cephoxitim), Piperacillin and chloramphenicol were highly sensitive (80-100%) followed by erythromycin and Gentamycin which were found to be effective between 40 to 60%. The drugs like tetracycline, penicillin and ampicillin had displayed resistance from 80-90%. The *Clostridium perfringenes* isolates were nearly 100% resistance to Lincomycin. Phylogenetic analysis of Sequences of PCR Products of *Clostridium perfringenes* (16srDNA) by 'DNA Star' computer software programme revealed that *Clostridium perfringenes* (G53) showed highest similarity (66.3%) with ATCC, 16sRNA *Clostridium perfringenes* followed by genomic DNA (42.9%-Gwalior). The genomic DNA (23.8%-UK) and 16sRNA from canine feces (23.5%-UK) had lower percent of identity with *Clostridium perfringenes* (G53). In the phylogenetic study of entrotoxigenic Clostridum perfringenes (G53 and G60) it was found that similarity with cpe equine- Canada and cpe Europe was 100%. The similarity of cpe (G53 and G60) was found lower with cpe (human-36.9%) and cpe serotype A (31.2%). Isolates from goat (cpe-G53 and G60) had shown 98.7% identity with each other.

Studies on the Post-harvest Quality and Spoilage of Prawn with reference to Microbiological and Biological changes

B. B. Sahoo and Dr. V. N. Bachhil

Ph.D. Thesis, Nov. 1995 **Chairman**

Prawns are the most important products of aquaculture and have got tremendous export potential. They are rich in protein and highly perishable. Faulty post-harvest handling results in deterioration of quality. A comparative study of post-harvest physic-chemical and sensory changes in *M .resembergii* (fresh water),*P.MonodonM. dobsoin*(brackishwater) and *M.dobsoin*(marine) prawns were conducted. Simultaneously the prawns were screened for pathogenic bacteria of public health significance.

It was found that pH values >7.0 could be taken as the critical point of acceptability. ERV values of less than 20 ml may be taken as the indicator of spoilage. Among the other tests TBV-N (>30 mg dN/100g), TMA-N (>5mg N/100g) and indole (>15mg/100g) may be taken as cut off points to assess the quality of prawn. High bacterial load of 7.82 (log cfu/g) was noted during the storage at ambient temperature. Total bacterial count of less than 10^7/g may be considered a safe limit for human consumption. Psychrotrophs, Proteolytics and Pseudomonas form a major part of bacterial flora of prawn spoilage. Species variation in electrophoretic pattern of sarcoplasmic protein bands were observed in the range of 20-24 KD and 66-70 KD. A decrease in low molecular weight sarcoplasmic protein bands was observed in all three species after storage. EDTA and 4-hexylresoricinol were found effective in increasing keeping quality as indicated by physic-chemical and microbiological observations.

Twelve serotypes of (E. coli), 4 Salmonella, 8 Staphylococcus, 5 A. hydrophila, 1 A. sorbia and 1 E. trada were isolated during at different stages of processing and storage. A mongst them 6 E. coli (0.146, 0:15, 0:88, 0:81, 0:8 and 0:10), all Samonellae (*S. tryhimurium, S. enteritidis* and*S. Virchow), A. Hydrophila, A. sorbia* and*E. tarda*were entero-pathogeneic when tested in RLIL. *V. parahaemolyticus* was Kanagawa positive and *V.* vulnificus was positive to suckling mouse oral infectivity test. Most of the pathogens showed the multiple drug resistant pattern.

Studies on Vacuum Packed Goat Meat and Effect of Organic acids on some Lactic Starter Cultures.

Y. Babji and Dr. T. R. K. Murthy
Ph.D. Thesis, June 1996 **Chairman**

The shelf life of fresh meat is limited even at refrigeration temperatures. Vacuum packaging technology has been used world wide to extend the shelf life of several type of perishable products. In order to know the changes that the goat meat would undergo during vacuum packed storage, it is essential to study the microbial and sensory qualities of the product. To further extend the shelf life of vacuum packed meats, pretreatment of goat meat with lactic acid, potassium sorbate, tetrasodium pyrophosphate or lactic starter cultures before vacuum packaging has also been investigated.

Minced goat meat samples were inoculated with cells suspensions of L. lactis sub spp. Lactis and L.Plantarum and vacuum packed in PET/PE laminate and stored at refrigeration temperature. Minced goat meat samples were also treated with cell suspension of L. bulgaricus, packed in cryovac and PET/PE laminate and subsequently stored at refrigeration temperature.

The shelf life of vacuum packed minced goat meat was 28 days and samples were spoiled by sulphide odours. Aerobically stored meat showed diminution in colour scores and spoiled by putrefactive odours on 21st day. Phosphate (0.5%) addition to minced meat increased the shelf life by 21 days compared with control. When meat by 21 days compared with control. When meat chunks were spray treated with2% lactic acid, there were increase in microbial inhibitions. 0.2 or 2% potassium sorbate treated samples had shown bright red colour up-to 42 days. The sorbate treated meat chunks showed a shelf life of six weeks when compared with three weeks in control.

Cell suspensions of L. lactis subspp. Lactic and L.plantarum showed microbial inhibitions but produced cabbage like off odours. When surface sanitized meat chunks were inoculated with cell suspensions of L.lactis subspp. Lactis and L.plantaram, the growth of indigenous flora of lactic acid bacteria increased. Samples when subjected to sensory evaluation, acid taste was noticed. When minced meat was inoculated with L. bulgaricus, it improved the colour although samples were spoiled by sulphide odours.

4.01 Developing traceability model for Indian buffalo meat industry: An NRCM initiative

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Traceability of meat is the ability to follow the movement of meat through specified stage(s) of production, processing and distribution *i.e.* throughout the value chain. Value chain refers to sequence of the stages and operations involved in the production, processing,
distribution and handling of feed and food, from primary production to consumption. Traceability is a part of the strategy to reduce the risk or minimize the impact of food borne disease problems. Most of the developed countries including European Union have made it mandatory to follow the traceability system. In India, no initiative has been taken and no effort has been made in this regard. By looking into this requirement, NRC on Meat, Hyderabad has initiated a research project which will have a database containing information about registered animals, farms and abattoirs. Each buffalo will be given an International Council for Animal Recording (ICAR) approved code which will be encoded on Radio Frequency Identification (RFID) device and put on to ears. Buffalo farms and abattoirs will also be registered, given a code and put on to the database. Farmers, in real time can update the database using a hand held device or through SMS messaging. After slaughter of animal, meat and meat products animal code can be carried forward as bar code. Consumers can trace back the origin using the code which can be retrieved using SMS messaging or through internet access. Confirmation of the traceability labeling can be achieved by microsatellite marker based molecular techniques. Most of the meat export from India is restricted to developing countries. To achieve exports to developed countries, India needs to have a robust traceability system in place and the same is being put up by NRCM on pilot basis to assist buffalo meat industry.

4.02 Antimicrobial and antioxidant effects of sodium acetate, sodium lactate, and sodium citrate in refrigerated chicken breasts cuts

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The microbiological quality and lipid oxidation of chicken breast cuts treated by dipping in 2.5% (w/v) aqueous solution of sodium acetate (NaA), sodium lactate (NaL), or sodium citrate (NaC) and stored at 1 °C. It was that these salts were efficient ($P<$ 0.05) against the proliferation of various categories of spoilage microorganisms; including aerobic and psychrotrophic populations, *Pseudomonas* spp., H2S-producing bacteria, lactic acid bacteria, and*Enterobacteriaceae*. The general order of antibacterial activity of the different organic salts used was; sodium acetate > sodium lactate > sodium citrate. Lipid oxidation, as expressed by peroxide value (PV) and thiobarbituric acid (TBA) value, was significantly ($P<$ 0.05) delayed in NaA- and NaC-treated samples. The antioxidant activity followed the order:
NaC > NaA > NaL. The shelf life of the treated products was extended by 4-7 days more than that of the control. Therefore, sodium acetate, sodium lactate, and sodium citrate can be utilized as safe organic preservatives for chicken breast cuts under refrigerated storage.

4.03 Sodium salts and their antimicrobial and antioxidant effects in vacuum packed chicken leg cuts under refrigeration

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The microbiological quality and lipid oxidation of chicken leg cuts treated by dipping in 2.5% (w/v) aqueous solution of sodium acetate (NaA), sodium lactate (NaL) and sodium citrate (NaC) followed by vacuum packing and stored at 1 °C. The study revealed that these salts were efficient ($P< 0.05$) against aerobic and psychrotrophic populations, *Pseudomonas* spp., H2S-producing bacteria, lactic acid bacteria, and *Enterobacteriaceae*. The general order of antibacterial activity of the different organic salts used was; sodium acetate > sodium lactate > sodium citrate. Lipid oxidation, as expressed by peroxide value (PV) and thiobarbituric acid (TBA) value, was significantly ($P< 0.05$) delayed in NaA- and NaC- treated samples. The antioxidant activity followed the order: NaC > NaA > NaL. The shelf life of the treated products was extended by 7-10 days more than that of the control. It was found that sodium acetate, sodium lactate, and sodium citrate can be utilized as safe organic preservatives for chicken leg cuts under refrigerated storage.

4.04 Influence of meat animal species on quality characteristics and fatty acid profile of meat

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Meat quality characteristics are affected by different production factors including genetic parameters, sex, age and animal diet. Species and tissue sites of the animals influence meat quality as well as fatty acid composition. Fatty acid composition in turn influences nutritive value and sensory characteristics of meat. In the present study effect of food animal species on the physicochemical characteristics and fatty acid profiles of twelve month Muzaffarnagari sheep and Barabri goat Longissimus dorsi was studied. Significant ($p<0.05$) effect of species was noticed on the proximate composition and other qualities parameters of meats where sheep meat had higher, moisture, pH value and protein contents while total pigments and water soluble proteins were higher in goat meat. Fatty acid profile of Longissimus dorsi was significantly ($p<0.05$) affected by species. Goat meat had higher desirable fatty acids (DFA), which include all unsaturated fatty acids and stearic fatty acid (C18:0) than sheep meat.

The average percentage of DFA in goat meat was estimated between 65 and 78%; the mean DFA value of Barbari goats was 71%, whereas in case of sheep meat, DFA was 63%. In this study, goat meat had higher polyunsaturated fatty acid to saturated fatty acids (PUFA/SFA) ratio than sheep meat (0.28 vs 0.20). These indicate the potential of Indian goats for the production of high-quality meat. Thus, it can be concluded that species has significant influence on the various quality characteristics and fatty acids of sheep and goat *longissimus dorsi* muscle.

4.05 Time temperature integrator for monitoring meat safety during temperature abuse

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For perishable commodities like meat, accurate control of temperature in supply chain is necessary to maintain the product quality and safety. Any fluctuation in temperature at any point during transport and subsequent storage will create great economic burden to the producer and health hazards to the consumer. In this perspective a reliable mechanism that can monitor any temperature abuse is necessary to check meat spoilage in supply chain. Therefore, a research was undertaken to develop a time-temperature integrator (TTI) based on enzyme substrate complex for monitoring safety of meat during temperature abuse conditions. Accordingly, an enzyme based time-temperature responsive system using a colour changing reaction by the action of enzyme α-amylase on iodine-starch clathrate complex was developed to monitor temperature abuse of meat in supply chain. Different levels of substrate and enzyme were optimized for developing the TTI. The suitability of the integrator to monitor temperature fluctuation was studied using simulated temperature abuse model in laboratory condition using an incubator. It was observed that the colour of the integrator packed along with frozen fresh meat was found to be changing when exposed to temperature abuse conditions. The results indicated that the colour changing response of the integrator can be efficiently utilized to reveal complete time-temperature exposure history of the product. It is concluded that the level of enzyme can be successfully altered to develop integrators suitable for different storage temperatures.

4.06 Organ chlorine pesticide residues in chicken muscles, fat, feed and water samples collected from broiler farms

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A study was conducted to estimate the levels of various organochlorine pesticide residues in broiler chicken muscle (24), liver (24), fat (24), feed (8) and water (8) samples collected from commercial farms in Hyderabad. In total, 88 samples were collected and analysed for the presence of pesticide residues using gas chromatograph equipped with an electron capture detector. Overall 40.9 % of samples were showed presence of pesticide residues. Among the samples, feed (62.5 %) and fat (45.8 %) showed higher level of contamination. Among the pesticides, residues of HCH (32 samples) were more frequently observed.

The concentration (ppm) of α HCH, β HCH, γ HCH, δ HCH, DDT, DDE, DDD, aldrin, dieldrin, endrin, endo sulfan, endosulfan sulfate, deltamethrin and cypermethrin in muscle tissues were 0.000827, BDL, BDL, 0.000702, 0.000687, 0.000359, BDL, 0.000379, BDL, BDL, 0.01095, BDL, 0.001839 and 0.005576, respectively. However, the levels of pesticide residues recorded in the study were lower than the maximum residue limit prescribed by Food Safety Standards Regulations (Contaminants, toxins and Residues), 2011

4.07 Survey of retail meat vendors of parbhani city of Maharashtra state in relation to food safety standards

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The food Safety act 2006 has constituted Food Safety and Standard Authority of India (FSSAI). It is mandatory to register the vendor for maintenance of food safety and hygiene. Most of the retail meat vendors are in unorganized sector in Parbhani city. A survey of the retail meat vendors of Parbhani city was made to asses availability of basic minimum amenities require for maintenance of food safety and hygiene, knowledge level about new food safety law and FSSAI standards and socioeconomic status of vendors. A total of 25 retail meat vendors from Parbhani city were selected randomly. All the vendors were given questionnaire for gathering information like gender, socioeconomic profile, educational status, hygiene levels. Knowledge level about food safety and waste disposal practices. A direct personnel contact with each and every meat vendor was made during survey. The questionnaires were assessed and data were analyzed in relation to each parameter it was observed that most of the vendors (61%) were primary level educated where as (33%) were illiterate. It was observed that only 6% vendors acquire post matriculation education. All the meat vendors were male only. All the vendors belong to Muslim community only, having low level of income per year (less than Rs. 1, 50,000). All the vendors follow traditional practice in relation to hygiene maintenance like disposal of waste in gutter and open lands, cleaning of shop with detergent and caustic soda. All the respondents were unaware about new food safety law 2006 and FSSAI registration process. It can be concluded that an effective extension programme is required for enhancing knowledge and technology transfer to retail meat vendors for effective implementation of food safety act 2006.

4.08 Occurrence and pathogenicity profile of *E.coli* isolated from processed meat products marketed in Mumbai, India

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Processed meat products available in the markets of Mumbai, India were analysed for the presence of *E.coli* using enrichment culture. The isolates obtained were tested for haemolysin and enterohaemolysin production as well as Vero cell assay. Analysis of 746 processed meat samples revealed presence of 62 isolates with 8.42% occurrence rate including 7.06% ready-to-eat and 1.35% ready-to-cook products. These 62 isolates of *E.coli* were isolated from chicken (26), beef (13), pork (13) and mutton (10) products. The products from restaurants, though, were found to be highly contaminated with *E.coli* than organized sector and lowest from street-vendors, a non-significant difference between the sources of collection as well as various products was noticed.

Distribution of haemolytic and enterohaemolytic property among different isolates revealed that from organised sector, restaurants and roadside preparations 20 (2.71%), 17 (2.30%) and 13 (1.76%) isolates were haemolytic and 22 (2.98%), 11 (1.49%) and 9 (1.22%) organisms were enterohaemolytic, respectively indicating presence of more number of haemolytic strains of *E.coli* than enterohaemolytic strains except in isolates from organised sector. Cytoxic potential of *E.coli* isolates was studied on Vero cell line which indicated that cytotoxicity was induced by only 6 (0.81%) of the isolates including 3 (0.40%) isolates from organised sector, 2 (0.27%) from restaurants and 1 (0.13%) from roadside preparations. Results of pathogenicity testing of *E.coli* isolates exhibited more haemolytic and enterohaemolytic activity than cytotoxicity on Vero cell line. Only 0.81%, 0.40% and 0.13% isolates from organised sector, restaurants and roadside preparations were positive employing all three tests which was also analysed statistically with highly significant differences ($P<0.01$) among the tests. The present study indicated that *E.coli* strains isolated were belonging to enterohaemorragic group.

4.09 Pathogenicity profile of *Staphylococcus aureus* isolated from processed meat products sold in Mumbai markets

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Staphylococcus aureus isolated from processed meat products collected from organized sector, restaurants and roadside outlets were tested for pathogenicity profile. A total of 174 isolates of *S. aureus* were recovered from 736 samples of processed meat product samples comprising beef (48), mutton (19), pork (41) and chicken (66) samples with an overall incidence of 23.64%. Among 654 ready-to-eat meat products, 159 samples were positive for *S. aureus,* while of the 82 ready-to-cook products, 15 were positive indicating an incidence rate of 21.60% and 2.03%, respectively. Coagulase production and expression of DNAse enzyme are considered as the important pathogenicity markers for *S. aureus.* The ability of *S. aureus* isolates to coagulate fresh rabbit plasma and to produce DNAse enzyme characterized by clearing of zone around inoculums on DNAse agar was tested as *in vitro* pathogenicity tests. Out of total 174 isolates of *S. aureus,* 134 (18.20%) coagulated rabbit plasma, 40 (5.43%) isolates showed DNAse activity while 23 (3.12%) isolates exhibited both coagulase as well as DNAse activity.

Again distribution of *in vitro* pathogenicity among 181 different sources viz. organised sector, restaurants and roadside preparations was 7.33%, 3.66% and 7.20% for coagulase test; 2.71%, 1.49% and 1.22% for DNAse activity and 1.35%, 0.67% and 1.08% for both, respectively. It was noted that more number of isolates exhibited positive reaction against coagulase test than DNAse reaction, however overall only 1.08% isolates showed both the reactions positive. Statistical analysis revealed significant variation ($P<0.01$) between the pathogenicity tests with regard to detection of pathogenic isolates indicating that coagulase test detected more number positive samples as compared to DNAse reaction. The differences were non-significant between the sources of collection.

4.10 Incidence of food-borne pathogens in street-vended foods in Mumbai

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Majority of the people in Mumbai depend and relish street-vended foods considering their convenience, availability and price with an adage that freshly prepared foods are always healthy. Considering this, 270 samples of ready-to-eat beef, mutton, pork and chicken products were screened for selected food-borne pathogens. Prominent market areas viz. Crawford market, Nagpada, Mahim, Sion koliwada, Dharavi and Govandi in Mumbai city were selected for the study. Maximum products were found positive for *S.aureus* (8.42%) followed by *Aeromonas* spp. (3.66%), *E. coli* (1.90%) and minimum for *Listeria* spp. and *Salmonella* spp. (1.76% each). *S. aureus* and *Salmonella* spp. were predominant in beef, chicken, mutton and pork (equal) products; *E.coli* were predominant in beef, chicken and pork (equal) and mutton products; *Aeromonas* spp. in beef, chicken, pork and mutton products; while *Listeria* spp. in chicken, pork, beef and mutton products, respectively. In the meat products procured from roadside outlets, *S.aureus* was isolated from maximum samples followed by *Aeromonas* spp., *E. coli* and equal numbers of *Listeria* spp. and *Salmonella* spp. Maximum isolates were recovered from beef products followed by chicken, pork and mutton products. Statistical analysis of the data revealed non-significant difference between various products as well as pathogens indicating no variation in occurrence of the pathogens in different products. Presence of food-borne pathogens in variable proportion raises a concern about safety of street-vended foods available in Mumbai markets.

4.11 Determination of PCR-RFLP profile for Indian fish species

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A method for identification of eleven fish species and their corresponding DNA admixtures has been developed based on the amplification of a specific part of the mitochondrial genome (Cytochrome *b*)using Polymerase Chain Reaction(PCR).To distinguish between the fish species, PCR-products were digested with three restriction enzymes viz., DdeI, HaeIII and NlaIII. Fragments obtained were resolved on the Bioanalyzer using a DNA 1000 assay, for analysis of fragment sizes and comparison with authentic species profiles. Fragment size data of Indian fish species were added to the Agilent Reference database in RFLP Decoder software, and a new user-created database was generated. Method validation was done for those fish species. Validated the data and compared with results obtained from the previous data available in Agilent reference data base. Finally identify the sequencing pattern of target gene. Polymerase chain reaction- restriction fragment length polymorphism (PCR-RFLP) fragment size analysis was used to Generate DNA profile of eleven Indian fish species using the Agilent 2100 Bioanalyzer.

A 464 base pair fragment of cytochrome *b* target sequence, found in all vertebrate fish, was amplified from fish DNA, and digested with three restriction enzymes, DdeI, HaeIII and NlaIII. Fragments obtained were resolved on the Bioanalyzer using a DNA 1000 assay, for analysis of fragment sizes and comparison with authentic species profiles. Fragment size data of Indian fish species were added to the Agilent Reference database in RFLP Decoder software, and a new user-created database was generated. Identified fish species molecular characterization done by sequencing analyisIdentified 4 species DNA admixture were subjected to PCR-RFLP Analysis to know the RFLP banding pattern.

4.12Effects of chitosan and irradiation on keeping quality of beef under chiller condition

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Chitosan, (Poly (β 1-4) N acetyl D - glucosamine) is a biodegradable polysaccharide, deacetylated product of chitin, isolated from naturally occurring crustacean shells by various process like deprotienisation, demineralisation and decolourisation. Chitosan exhibits various biological activities including antimicrobial and antioxidant effects and could be used as a preservative for meat and meat products. The effect of Chitosan and irradiation on microbiological, lipid oxidation and sensory qualities of beef stored for 10 days at 4 °C were investigated. Chitosan was applied to freshly harvested Longisimus Dorsi muscle of beef at the rate of 1.5% (w/w) of initial weight and both the control and Chitosan added samples were irradiated at 2.5kGy. Control, Chitosan added and irradiated samples were stored at 4^0C for 10 days. Sample were analysed on 0^{th}, 4^{th}, $7^{th}$and 10^{th} day. Microbiological analysis included the enumeration of total viable count, yeasts and moulds counts and psychotrophic bacterial counts, while pH values were also determined. Lipid oxidation was evaluated through measurement of TBARS value.

The experimental result indicated that the samples irradiated with chitosan showed better preserving effect. Samples irradiated with chitosan could significantly lower the total viable count, yeasts and moulds counts and psychotrophic bacterial counts, and also allow a better control of pH and lipid oxidation (TBARS) in beef muscle as compared with non chitosan added batches. Chitosan showed most intense antioxidative effect as evidenced by significantly lowering the TBARS value ($P< 0.05$) that it could reduce the lipid oxidation caused by irradiation. Shelf life of samples containing chitosan was almost doubled compared to the control samples, where as the highest shelf life was obtained for samples irradiated with Chitosan. In conclusion, the best antimicrobial and antioxidative effects were obtained from the combination of Chitosan with irradiation. The present study demonstrates the beneficial effects of Chitosan and irradiation in preservation of meat, thus improving the quality and extending the shelf life of the sample under chiller storage condition.

4.13 Effect of acidic and alkaline marinades on the quality of poultry meat

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Traditionally meat has been marinated to improve flavor, tenderness and to increase product shelf life. A study was undertaken to evaluate the effect of acidic marinade i.e. sodium citrate in comparison with alkaline marinade i.e. sodium tripolyphosphate. Multi needle injection method is adopted to inject the exact quantity of the marinade into the meat.

The marinade is injected as the needle is withdrawn, spreading the marinade throughout the piece.

The chicken meat treated with acidic marinade recorded significantly ($P<0.05$) higher flavor, texture and tenderness scores but lower pH, moisture, water holding capacity when compared to alkaline marinade. There was no change in the drip loss between two marinades. Total plate counts were significantly ($P<0.05$) lower for acidic marinade treated meat. Based on the above results it can be concluded that acidic marinades can be used to increase the shelf life of the product.

4.14 Soil, water and meat, relation in residues of heavy metal

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The concentration of heavy metals (As , Cd ,Cr , Cu ,Fe ,Mn, , Pb, and Zn) in soil, water and chevon (40-week-old), were studied in different agro-climatic zones of West Bengal using the GBC, 932B plus atomic absorption spectroscopy (AAS). The levels of heavy metals in soil, water and chevon were recorded. Some heavy metals like Cr, Cu, Fe and Zn in soil and As and Fe in water were found to be at higher sides whereas metals like Cd in soil and water and As, Cd, Cu, Cr and Pb in chevon where below detection limit.

The concentrations of metals in the soil, water and chevon were statistically significant (P □ 0.05),when compared with reference values of MFPO and other studies. The result suggests that heavy metal residues in chevon remain within the tolerance limits, even when the animal is reared in heavy metal-polluted environment.

4.15 Assessment of microbiological quality of meat samples in Hyderabad- Karnataka region

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In the present research work, over 300 raw meat samples of different species (50 Beef, 50 Carabeef, 50 Mutton, 50 Chevon, 50 Pork and 50 Chicken) were colected from local slaughter houses and retail outlets in Hyderabad- Karnataka region and analysed for microbiological quality. The methods employed for microbiological quality assessment were Standard plate count, Selective plating, Microscopic examination and Biochemical characterization. Selective plating, microscopic examination and biochemical characterization were done for the microbes; *Staphylococcus, Bacillus, Clostridium, E. coli, Salmonella & Listeria* species.

As per FSS regulations 2011 and Prevention of Food Adulteration Rules, 2004 for meat and meat products, the standard plate count should be 10000/gram maximum. In this study, of the 300 samples analyzed, 89 (29.66%) [18 (36%) beef, 23 (46%) carabeef, 15 (30%) mutton, 12 (24%) chevon, 11 (22%) pork and 10 (20%) chicken] meat samples exceeded the limit of 10000/gram. As per FSS regulations 2011, the standards for various organisms are; *E. coli* - 100/gram maximum, *Samonella* - absent in 25 gram, *Staphylococcus aureus* - 100/gram maximum, *Clostridium perfringens* - 30/gm max and *Listeria monocytogenes* - Absent in 10 gram. In this study, the no of meat samples positive for *Staphylococcus, Bacillus, Salmonella and E. coli* were 25, 9, 15 and 30, respectively.

The number of meat samples that exceeded the limits for *Staphyococcus* were 20 (6.66%), for *Salmonella* were 15 (5%) and for *E. coli* was 22 (7.33%). None of the samples were positive for *Listeria and Clostridium* spp. The number of the meat samples that show poor microbiological quality is significantly very high and very alarming and eccentuates the importance of upgrading the slaughter houses and retail outlets and training of the personnel regarding hygienic meat production.

4.16 Detection of organochlorine pesticide residues in beef and mutton samples and effect of cooking on residual level of aldrin and dieldrin

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Continued and indiscriminate use of pesticides has resulted in accumulation of Pesticide residues into food and feed and wide spread contamination of environment. Higher stability, lipophilic nature and persistence of these chemicals in the environment led to the contamination of foodstuffs, especially those having high fat content such as milk and meat products. A study was conducted to estimate certain organochlorine (OC) pesticide (DDT, HCH and cyclodiene compounds) residues in beef and mutton (40 samples each) collected from different regions of Andhra Pradesh by gas chromatography (GC). The residues of organochlorine pesticide residues were found in majority of the analyzed beef and mutton samples.

The contamination levels of OC pesticides detected in beef and mutton samples were 0.184 and 0.186 ppm of p,p'DDT- para para dichloro diphenyl trichlore ethane, 0.163 and 0.178 ppm of p,p'DDE- para para dichlorodiphenyl dichlore ethane, 0.155 and 0.127 ppm of p,p'DDD- para para dichloro diphenyl dichloroethylene, 0.074 and 0.039 ppm of αHCH (hexachloro cyclo hexane), 0.058 and 0.046 ppm of β HCH, 0.081 and 0.058 ppm of γHCH, 0.051 and 0.022 ppm of δ HCH, 0.046 and 0.031 ppm of endosulfan sulfate, 0.040 and 0.040 ppm of heptachlor, 0.037 and 0.031 ppm of heptachlor epoxide, 0.023 and 0.020 ppm of aldrin and 0.019 and 0.022 ppm of dieldrin respectively.

However, the levels of contamination were quite low and well below the maximum residue levels specified by national and international regulatory bodies. Cooking of aldrin and dieldrin spiked beef resulted in 31.02-35.98% reduction in aldrin and 28.91-34.60% reduction in dieldrin. Among the cooked samples, higher reduction in the residue level was noticed in pressure cooked meat samples, followed by boiling and microwave oven cooked samples.

4.17 Heavy metal residues in samples of beef, mutton, pork and chicken by atomic absorption spectrophotometer (AAS)

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Heavy metals like lead, cadmium, arsenic, mercury constitute a very serious form of Pollution, because they are stable, non-biodegradable and have the potential for bio-accumulation and bio-magnification. Living organisms require trace amounts of some heavy metals including Iron, Copper, Cobalt, Manganese, Molybdenum, Vanadium, Strontium, Arsenic, Selenium and Zinc, but excessive levels can be detrimental to the organism. The concentrations of heavy metals (Pb, Cd, Cu, Zn and Cr) in beef, mutton, pork and chicken samples (40 each) collected from different regions of Andhra Pradesh were determined after nitric acid/perchloric acid digestion using Atomic Absorption Spectrophotometer (AAS).

The heavy metal residues were found in almost all the analyzed meat samples. The levels of heavy metals in beef, mutton, pork and chicken samples ranged from 1.46 to 1.92±0.036µg/g Pb, 0.71 to 0.81±0.041µg/g Cd, 2.70 to 5.13±µg/g Cu, 33.31 to 43.19±µg/g Zn and 0.95 to 2.17±µg/g Cr. In most of the cases, the levels of contamination were low and below the maximum residue level except in case of lead and zinc, where 2.5% and 15% samples exceeded the maximum permitted limit for lead and zinc respectively.

4.18 Molecular characterization of Shiga - toxin producing *E.coli* from poultry faces

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The study was designed to ascertain the incidence of Shigatoxin - producing Escherichia coli from the faeces of poultry collected from the unorganized poultry farms in and around Tirupati and from the poultry farm associated with College of Veterinary Science, Tirupati, Andhra Pradesh, India, and also the molecular characterization of the isolates to detect the virulence genes and to determine their antibiogram patterns so as to identify the best therapeutic regime and to control the spread of antibiotic resistant strains. A total of 200 poultry faecal samples were collected from various organized and unorganized poultry farms, Escherichia coli was isolated from the samples and they were subjected for direct multiplex PCR to detect the virulence genes like stx_1, stx_2, eaeA and hlyA. Blood agar plate test was done to find out the haemolysis production by the isolates.

The antibiogram patterns of isolated strains were determined on Muller - Hinton agar by using disc diffusion method and in this test 20 antibiotic discs were used viz. Tetracycline (30µg), Polymyxin B (300 units), Chloromphenicol (30µg), Cephalothin (30µg), Kanamycin (30µg), Trimithoprim/ Sulphamethoxyzole (25µg), Ampicillin (20µg), Nitrofurantoin (300µg), Streptomycin (10µg), Amikacin (30µg), Gentamycin (10µg), Neomycin (30µg), Ofloxacin (5µg), Piperacillin (100µg), Cefotaxime (30µg), Cefuroxime (30µg), Cefazolin (30µg), Cefapime (30µg), Imiperem (10µg) and Lomefloxacin (10µg). All the isolates were subjected to multiplex PCR by using touch down protocol. Out of 200 isolates 42 (21%) samples were positive for Shigatoxin - producing Escherichia coli.

Among these 42 Shigatoxin -producing Escherichia coli 23 (54.76%) isolates carried stx_1, stx_2, eaeA and hlyA genes, 7(16.66%) isolates carried stx_1, 4(9.52%) isolate carried stx_2, 3(7.14%) isolates carried stx_2 and eaeA, 2(4.76%) isolates carried hlyA and another 3 (7.14%) isolates carried stx_1, stx_2, and hlyA genes. Phenotypically 68 (34%) isolates were haemolytic on sheep blood agar.

The antibiogram of the isolates revealed that 83 Shigatoxin - producing Escherichia coli were resistant to 15 antibiotics tested. From this study it was observed that there is a prevalence of multi drug resistant Shigatoxin - producing Escherichia coli in poultry faeces, tirupati of Andhra Pradesh, India which is having greatest public health significance and indicating a great threat to the human health.

4.19 Isolation and molecular characterization of isolates of *Clostridium perfringens* from goat meat

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The aim of the present study was to observe the occurrence of *Cl. perfringens* and its enterotoxigenic strains in goat meat through isolation and molecular typing with PCR, respectively. A total of 100 meat samples of goat were subjected for isolation of *Cl. perfringens* with tryptose sulphite cycloserine agar (TSC).

Isolation with TSC and further biochemical characterization revealed that 58 samples of goat meat were positive for *Cl. perfringens*. Molecular typing with duplex PCR of 30 isolates of *Cl. perfringens* disclosed that all the 30 isolates were positive for *Cl. perfringens* with PCR, but only 8 isolates were found to be enterotoxigenic.

4.20 Detection of *Listeria monocytogenes* in livestock products by PCR technique

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Listeria monocytogenes has been recognized as an important emerging food borne pathogen due to its widespread distribution in nature. The major source of infection is due to consumption of contaminated vegetables, meat, dairy products and sea food products with Listeria species. Though conventional culture method continues to be an official method for the detection of L.monocytogenes, it takes 4-5 days for isolation and consequent confirmation of L. monocytogenes in food stuffs. Hence, there is a need to develop reliable and rapid methods for detection of L.monocytogenes from foods. The present study was undertaken to standardize PCR assay for detection of L.monocytogenes and Listeriolysin O from livestock foods and compare its efficacy with conventional cultural methods.

A set of primer derived from iap gene and other set derived from hlyA gene were used for detection of L. monocytogenes and Listeriolysin O in the PCR assay. The specificity of the standardized PCR assay for the two primers was tested by subjecting 8 isolates including L.monocytogenes and seven other non-Listeria monocytogenes bacteria.Only L.monocytogenes isolates gave specific product of 131 bp for iap and 456 bp for hlyA genes respectively. The sensitivity of the PCR assay was evaluated by subjecting serial 10-fold dilution of pure culture of L.monocytogenes from 4.0X107cfu/ml to 4.0 cfu/ml to PCR assay with two sets of primers.

The minimum detection level was found to be 4 cfu/ml. Four different broths i.e. two non-selective and two selective broths were evaluated to assess their PCR compatibility using four different treatments for concentrating the target organism (i.e. heat lysis after two step of centrifugation, heat lysis after single step of centrifugation, first centrifugation, then heat lysed and centrifuged again, heat lysis method using NaOH and Sodium dodecyl sulfate). Two non-selective broths (BHI and TSB) produced bands in all four treatments, but they were found as light. Among selective broths, LEB gave very bright bands to treatment-1 and 2 and bright bands to other treatments whereas PALCAM medium gave bright bands to treatment-1 and 2, and gave light bands to other two treatments. Out of 150 naturally contaminated samples (25 each of pork, pork swabs, chicken, chicken swabs, fish, fish swabs samples) screened for L.monocytogenes (iap) and Listeriolysin O (hlyA), PCR gave 16 positive results out of which 4, 1,4,3,2 and 2 were positive for the above given samples respectively, where as cultural method gave 8 samples, of which the above given samples were positive for 2, 1,2,1,1 and 1 respectively.

The present study also suggests the need for improving food safety through the implementation of hygienic measures at all levels from production to consumption with particular emphasis on ready-to-eat food items which require no further heat treatment. PCR was found to be a suitable test for screening of food samples for L.monocytogenes in a rapid way. Overall sensitivity of PCR was higher than cultural method and amenable to automation. Quite a significant percentage of food samples were found to be contaminated with L.monocytogenes. This indicates measures for improving the hygienic practices.

4.21 Microbiological quality of marketable chicken and mutton in Hyderabad city and its public health significance

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The study was conducted to assess the microbiological quality i.e. total viable and coliform counts and presence of *E.coli*, *Staphylococcus aureus* and *Salmonella spp.* of 50 samples of (25 each) chicken meat and mutton, collected from and retail meat shops of Hyderabad and slaughter houses. Of the 50 samples only 36% (9) of chicken and 48% (12) of mutton showed acceptable levels of total viable counts as per ICMSF (1974), while 52% samples were positive for coliforms. *E.coli* and *Staphylococcus spp*. were present in 70% and 58% samples respectively, whereas, only 2% of the samples were found positive for the presence of *Salmonella spp*.

Poor microbiological quality recorded in this study emphasizes need to undertake urgent measures for hygeinic control.

4.22 Evaluation of bacterial contamination of raw meat sold in and around the Hyderabad city and its public health significance

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An investigation was carried out to assess the microbiological quality i.e. total viable count (TVC), and the prevalence of E. coli, Staphylococci spp. and Salmonella spp. in meat marketed in around Hyderabad city. In all 45 samples comprising 15 poultry, 15 chevon and 15 beef were collected from various retail shops aseptically. The results revealed highest average (log 6.28±0.06/g) TVC in chevon followed by poultry meat (log 6.10±0.06/g) and least in poultry (log 6.07±0.12/g).

A total of 15 samples were found positive for E. coli, 5 samples for Salmonella spp. and 17 samples were positive for Staphylococci spp. The E. coli was isolated from 7 samples of chevon, 5 samples of beef and 3 samples of poultry meat, Salmonella spp. was isolated from 2 samples of poultry meat, 1 sample of beef and 2 samples of chevon, whereas Staphylococci spp. was isolated from 9 samples of chevon, 5 samples of beef and 3 samples of poultry .

The findings of present study confirm the prevalence of E. coli, Staphylococci spp. and Salmonella spp. in retail meat samples is an indicative of contamination in meat supply chain and therefore is a matter of concern from public health point of view

4.23 Incidence of *Salmonella* species in raw chicken from Mumbai city

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A present study was carried on 40 samples of raw Chicken samples, 20 each of muscles and liver collected from local Chicken market and around Mumbai City, were processed for isolation and identification of Salmonella spp. Pre-enrichment and enrichment was carried out in tetrathionate broth (TTB) followed by plating on selective media Bismuth Sulphite Agar (BSA). The colonies showing typical colony characteristics were confirmed on the basis of their morphological and biochemical characteristics.

A total of 1 chicken sample were found positive for salmonella with overall prevalence of 2.5%, were chicken muscle sample found to be more contaminated than liver sample with the salmonellae. The finding of present study confirm prevalence of Salmonella spp.in retail meat sample and therefore owing to the potential human health hazard of pathogenic Salmonella spp.to the consumers, it is important to put more emphasis on food hygiene and such surveillance studies for sustenance of public health.

4.24 Isolation and characterization by PCR of *E. coli* from retail poultry meat and different sources in retail poultry meat shops in Parbhani city

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Food borne *E. coli* are important pathogens of public health importance. *E. coli* is often suggested as indicator organism because it reliably reflects faecal contamination. In Semi-urban areas the retail poultry meat is processed and sold in unhygienic conditions. In the present study an attempt was made to isolate *E. coli* from retail poultry meat and different sources poultry meat shops in Parbhani city. A total of 240 swab samples of different sources viz. utensils, platform, personnel, water and poultry meat were collected from five retail poultry meat shops in six lots. Isolation of *E. coli* was done by selective plating on Eosine Methylene Blue (EMB) agar (Himedia Laboratories, Mumbai). Characteristic colonies of *E. coli* showing green colour with metallic sheen were further used for identification by biochemical tests and sugar fermentation tests. A total 74 *E. coli* isolates were obtained from all the sources with overall prevalence of 30.83 percent.

The prevalence rate of *E. coli* for different sources viz. knife, scalding tank, defeatherer, dressing table, platform, personnel, water and poultry meat was 30, 33.33, 23.33, 46.67, 16.66, 6.67, 43.33 and 46.67 per cent respectively. The highest percentage of positive samples 46.67 percent out of the overall isolates were seen from dressing table and poultry meat. Molecular characterization of 12 randomly selected representative isolates was done with the help of PCR by targeting the species specific *pal* gene. All the 12 isolates subjected to PCR were confirmed. The presence of *E. coli* indicates there is need of hygienic measures during poultry slaughtering specially the cleaning of wooden dressing table and hygienic processing till the poultry meat reaches to the consumers.

4.25 Intelligent packaging devices for monitoring quality and safety of meat during storage conditions

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The intelligent packaging devices prove as a monitoring tool to assess the quality and safety of meat during storage conditions. Thereby the wholesalers/retailers of meat can withhold the unsatisfactory meat, if found, before inadvertently keeping them in display cabinets for sale. Moreover the intelligent packaging devices give authentication to the consumers about the safety of the meat. If these devices are made available, legal issues arising out of unsatisfactory meat versus consumer oriented disputes can be prevented. Hence these devices will be useful in upholding reputation of the brand in the market and preventing undue loss of money to the company. In Indian market, intelligent packaging devices are not available in meat supply chain. But this is highly essential in the rising food poisoning cases and increasing global export-import market. Keeping this in view, a research was undertaken to develop intelligent packaging devices for monitoring meat quality and safety under storage conditions.

The intelligent packaging devices were developed based on chemical solutions, natural dyes and enzyme-substrate complex. The devices based on chemical and natural dyes were placed either inside the packaged meat as strip or sensor. These devices reacted with the metabolites produced by bacterial growth during storage and resulted in a significant color change when the meat became unacceptable. Whereas the device based on enzyme-substrate complex changed colour with change in storage temperature of the meat above 10^{o}C for a considerable time period. These color change in intelligent devices could successfully indicate about the quality and safety acceptability level of meat under storage conditions. This technology would enable the meat industry to prevent the cases of food poisoning occurring due to processing products from unsatisfactory meat.

4.26 Quality and safety assurance of meat in supply chain

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In spite of good manufacturing practices and food safety standards followed at various manufacturing plants, the estimated shelf life of the meat gets decreased due to negligence or break down in cold chain/interrupted power supply eventually resulting in meat spoilage in supply chain. If a field kit / an indicator sensor are made available to monitor the quality changes during temperature abuse in supply chain, it will benefit both the manufacturers and consumers. The manufacturers can track the quality and withhold the unsatisfactory meat before they find their place in the display cabinets for sale. Moreover the consumers will confidently purchase meat without any doubt over the quality simply by observing the colour change in the biochemical test of the field kit or through colour change in the indicator placed in the packaged meat. Till date there is no such field kit/sensor is available in Indian market. Even the literatures available in this area of research are very scanty.

Therefore, a program has been designed with an objective to develop field kit and indicator based sensor for monitoring meat safety in supply chain. In the first experiment, a field kit was developed based on indicator chemicals which could change color with increase in microbial load of the stored meat. In the second experiment, indicator sensors were developed based on chemical solutions and natural dyes. These indicator sensors could successfully reveal the status of quality and safety of the packaged meat through the change in color of the indicator sensor. Hence it is concluded that the developed biochemical test and indicator sensors can be successfully used as quality and safety assurance tools for the meat in supply chain.

4.27 Metallic residues concentration in goat tissues

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A study was made to detect the metallic residues viz., arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb) and zinc (Zn) in muscle, liver and kidneys of Salem black goat that were sold at different meat shops in and around Mecherry region (Salem district of Tamilnadu).

A total of 60 samples were collected and it metallic residues were detected using inductively coupled plasma- mass spectrometry (ICP-MS).Results indicated that arsenic concentrations ranged from 0.014- 0.035, 0.011-0.040, 009- 0.428 ppm, cadmium ranged from 0.007-0.013, 0.031-0.130, 0.020-0.095ppm, chromium ranged from 0.478- 2.915, 0.326-3.049, 0.229- 2.315ppm, copper ranged from 0.746-5.852, 18.139- 56.053, 1.813-65.665ppm, lead concentration ranged from 0.099- 0.354, 0.067-0.340, 0.060-228ppm and zinc concentration ranged from 15.000-48.294, 25.120-103.492, 7.892-45.253ppm in muscle, liver and kidneys of goat tissue, respectively.

Out of six metallic residue concentration analyzed, concentrations of four were below the maximum permissible level (MPL) prescribed by (MFPO, 2004) with the exception of copper and zinc which had relatively higher concentration in some tissues of goat.

4.28 Organ chlorine pesticide residues in market samples of broiler and desi chicken

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The present study was conducted to estimate the levels of various organ chlorine pesticide residues in market samples of broiler and desi chicken collected from in and around Hyderabad city. A total of 60 samples (each 15 muscle and fat samples of broiler and desi chicken) were analysed for the presence of organ chlorine pesticide residues using gas chromatograph equipped with an electron capture detector. Pesticide contamination was noticed in 55% of analyzed samples. The percentage of pesticide contamination recorded in broiler and desi chickens samples were 83.33 and 26.6, respectively.

Among the pesticides, DDT, HCH, aldrin, endrin, heptachlor and endosulphan residues were detected in broiler chicken samples. The overall concentration of DDT, HCH, aldrin, endrin, heptachlor and endosulfan residues in muscle and fat of broiler chicken were 0.026, 0.006, 0.003, 0.007, 0.004 and 0.005 ppm, and 0.11, 0.122, 0.108, 0.012, 0.03 and 0.055 ppm, respectively. Only DDT and HCH residues were detected in desi chicken samples and the overall concentration of the same were (0.002 and 0.006 ppm) and (0.05and 0.013 ppm) in muscle and fat, respectively.

The study revealed that the market samples of broiler chicken had higher incidence and levels of residues as compared to that of desi chicken samples and the concentration of pesticide residues in both broiler and desi were higher in fat samples compared to muscle samples. Further the levels of pesticide residues recorded in the study were lower than the maximum residue limit prescribed by Food Safety Standards Regulations (Contaminants, toxins and Residues), 2011.

4.29 A rapid method for authentication of beef and pork by FINS and PCR-RFLP of mitochondrial cytochrome b gene

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In India, export of beef (cattle meat) is strictly banned. In spite of ban, cows and Bullocks are occasionally slaughtered and adulterated with buffalo meat for export. Also, Hindus have taboo for beef, while Jewish and Muslim populations choose to avoid consumption of pork due to their religious belief. However, the example of mislabelling is prevelent and is punishable under Food Safety & Standards Act, 2006. Food analysts are often asked to test, authenticate and certify meat samples in cases involving adulterations or misrepresentations. Several techniques have been in use in the past and molecular techniques are considered as 'techniques of choice' for meat authentication.

In the present study PCR based techniques based on Forencically informative nucleotide sequencing (FINS) and polymerase chain reaction-restriction fragment length polymorphism (PCR-RFLP) for authentication of beef and pork have been develped. DNA was extracted by alkaline lysis and Phenol: chloroform methods. A set of universal primers were designed targeting mitochondrial cytochrome B gene. PCR amplification yielded 450 bp in beef and pork samples. Amplicons was sequenced and aligned using Basic Local Alignment Search Tool (BLAST) of NCBI. Beef and pork samples showed 98% similarity with in the species. Based on RE mapping restriction enzymes were selected for developing RFLP assay.

Restriction enzyme digestion of the PCR product of 450 bp with *MspI* restriction enzymes resulted in pattern that could authenticate and differentiate beef and pork. Mitochondrial cytochrome B gene of cattle was cleaved into 198+252 bp amplicon where as that of pig is 61+389 bp fragments, respectively. Techniques are very sensitive and reliable, accurate and rapid.
Techniques can help food analysts to solve the problem of animal species authentication.

4.30 Buffalo (*Bubalus bubalis*) meat authentication by forensically informative nucleotide sequencing (FINS)

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Carabeef (buffalo meat) is a major item of export from India. But export of beef (i.e. cattle meat) is prohibited. Adulteration of beef with that of carabeef is a common fraudulent practice because of prohibition of cow slaughter in most states of India. Secondly, there is a malpractice among meat vendors to mix the low priced meat such as carabeef (even sometimes the banned cow meat) with other costlier meats like goat (chevon) and sheep (mutton) meats to gain monetary benefits, which is an economic fraud and offence under Foof safety and Standards Act, 2006. Under such circumstances, the consumers would have questions pertaining to the surety and authenticity of the origin of meat. Keeping in view these peculiarities in India, carabeef identification has become an essential element for food quality control and forensic analysis.

So a novel PCR based technique Forensically Informative Nucleotide Sequencing (FINS) was developed using newly designed oligonucleotide primers targeting mitochondrial Cytochrome B gene. Genomic DNA was extracted from the buffalo meat by Phenol: Chloroform method. 450 bp PCR amplicon was sequenced and aligned using Basic Local Alignment Search Tool (BLAST) of National Cetnre for Biotechnology Information (NCBI).

Nucleotide sequence showed 98% similarity with buffalo (*Bubalus bubalis*), 88% similarity with cattle (*Bos indicus*), 86 % with sheep (*Ovis aries*), 86% with goat (*Capra hircus*), 75% with chicken (*Gallus gallus*) and 82 % with pig (*Sus scrofa domestica*) Cytochrome B gene sequence. The technique is very sensitive, reliable and accurate method of species authentication. Method is highly specific and reliable and more specifically applicable even in cooked meat.

4.31 Use of natural indicator dyes for monitoring quality and safety of meat

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With greater emphasis on meat safety in storage and supply chain, there is a need to develop monitoring system for real time estimation of freshness and safety of meat throughout the supply chain. Therefore a program was designed to develop a natural dye based indicator for monitoring the meat safety under storage conditions. The principle of the experiment was based on the response of the natural indicator when it reacts with the basic metabolites released during the storage of meat. Accordingly efforts were made to extract natural dyes from different sources using different solvents and methods.

The natural indicator was fabricated using the extracted anthocyanins coated on to a suitable carrier and packaged in a suitable material. Then the response of the indicator was studied in an indicator - metabolite reactive model, simulating production of volatile bases produced during stored meat. It was observed that the indicator changed its colour when placed in a reactive model but it did not produce any change in colour when kept without the metabolite.

It is concluded from the significant response of the indicator that extracts from the natural sources can be successfully used for developing a suitable food grade indicator system for monitoring meat quality and safety in supply chain.

4.32 Determination of biofilm and ESBL producing meat isolate of *Klebsiella pneumonia*

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Microbial food safety and food-borne infections are important public health concern worldwide. Consumption of contaminated raw or undercooked meat, poultry, eggs, or seafood poses a health risk to the elderly, young children and other highly susceptible individuals with compromised immune systems. In the recent years prevalence of multi drug resistant *Klebsiella pneumoniae* (MRKP) strain is evident in many developing countries including India. *Klebsiella pneumonia* is known as an important food borne bacteria and causes severe illness in immunologically compromised individuals. The aim of the present study was to evaluate the *Klebsiella pneumonia* from different meat samples including chicken, bovine, and goat.

Totally each 10 samples were processed for the detection of multi resistant *Klebsiella pneumonia.* Among all the meat sources, highest occurrence was observed in goat meat sample (70%), followed by bovine (60%) and chicken (10%). In this study, we also investigated the prevalence of extended-spectrum β-lactamase (ESBL) by identifying through the amplification of *SHV, TEM, CTXm* and *OXA* genes by multiplex PCR. *TEM* were highly observed in all meat isolates followed by *CTXm.*

This result also correlated well with biofilm formation. Most of the biofilm producing isolates had number of ESBL genes. Increase in ESBL producing *K. pneumoniae* is a serious threat and often express resistance to multiple antibiotics and complicates antibiotic therapy. Continuous surveillance of raw meat samples and use of appropriate screening tests for laboratory detection of multi drug resistant pathogens to ensure hygienic meat supply.

4.33 Authentication of beef by mitochondrial D-loop based polymerase chain reaction assay

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Authentication of meat is essential owing to public health, economic, religious and legal concerns. A species-specific PCR assay targeting mitochondrial D-loop region was developed for identification of beef (*Bos indicus & Bos taurus*). A pair of forward and reverse primers yielding a species-specific PCR product 380 bp was designed against the conserved region of mitochondrial D-loop of cattle.

The PCR assay was checked for cross amplification against 25 animal species comprising of mammals, birds, rodents and fish. No amplification was seen in any of the species studied. Primers successfully amplified the targeted region in raw (n=20 each), cooked (60, 80 and 100ºC), autoclaved (121ºC) and micro-oven processed beef samples. Sensitivity of the assay was as low as 0.1% for the detection of meat adulteration and limit of detection (LOD) of cattle DNA was 0.1 pico grams.

Novel PCR assay developed in this study was highly sensitive and has applications not only in the forensic science but also for the detection of meat adulteration arising from fraud in the trade of meat derived from the cattle especially in the Indian subcontinent.

4.34 HACCP based food safety system in a typical fresh frozen buffalo processing unit

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Fresh frozen buffalo processing unit is committed for implementation of an effective HACCP system. During hazard identification, evaluation and subsequent operations in designing and applying HACCP system consideration has been given to the impact of raw materials, ingredients, food manufacturing practices, role of manufacturing processes to control hazards, likely end use of the product, categories of consumers of concern, and epidemiological evidence related to food safety.

The intent of the HACCP system is to focus control of CCPs. Redesign of the operation is considered if a hazard which must be controlled is identified but no CCPs are found. HACCP is applied to each specific operation separately. HACCP application is reviewed and if necessary the changes are made when any modification is made in the product, process or any step. During HACCP implementation due consideration has been given to the nature and size of the operation.

Basically all the activities, being carried out at Fresh frozen buffalo processing unit, inside the premises are included in the scope. The scope for the application of the HACCP based Food Safety System in Fresh frozen buffalo processing unit. Scope of application includes Receipt and unloading of carcasses, washing, chilling,de-boning, fresh packing, freezing, frozen packing,container loading, dispatch. Haccp system requires management responsibility, food safety policy, resources**,** Product Characteristics and Intended use**,** hazard analysis, parameters and critical limits, monitoring and measuring, product release, corrective actions, product recall, validation.

4.35 Chemical based indicator for non-destructive evaluation of meat safety

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Evolutions of modern storage facilities have made it possible to transport meat to long distances and store for long duration. Meanwhile, they have added an extra burden to monitor the safety and freshness during transport which may be compromised at times. Since the era is of greater stringency in relation to hygiene and safety issues associated with fresh and processed meat, it is of great value to develop a meat safety monitoring system in supply chain.

Accordingly efforts were made to develop a suitable meat safety monitoring system in supply chain. Different chemical dyes were selected based on their sensitivity to volatile basic nitrogen released from the stored meat for the development of suitable indicator system for monitoring of meat safety in supply chain. The group of chemicals selected include methyl red, bromocresol green, phenol red, bromophenol blue, different acids, alkali, and alcohol.

The different levels of chemicals were optimized either alone or in combination and indicator solutions were prepared. The standardized indicator chemicals were coated in a suitable carrier, placed along with the packaged meat and observed for colour change on reaction with metabolites released from stored meat. It was observed that the colour of the indicator changed from its original colour as the storage progressed. The results indicated that the colour changed to a completely different colour as the meat reached its end of storage life with increasing microbial load and consequent increase in concentration of volatile metabolites.

It is concluded that different combinations of indicator chemicals can be successfully used to develop a suitable indicator system for monitoring meat safety in supply chain. Hence the consumers can easily monitor and judge the quality of meat just by viewing at the colour change of the indicator present in the packaged meat.

4.36 Acceptability and shelf stability of further processed sundried dried chicken meat products.

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Studies were carried out for effective salvaging of dried meat that was previously prepared by using standardized spice mix including salt up to 2% salt and pretreated with 6 % and 8% soya followed by sun drying for about 7 days at a temperature of 28- 34°C and storage at an ambient temperature (30±2°C) for over a year had been utilized for development of further processed chicken meat products and evaluated for its quality.

Accordingly developed three highly sensorially tasteful, microbiologically stable further processed chicken snack products namely Y-shaped, pappad shaped and cylindrical shaped snacks and its microbiological ecology and micro biological quality studied with reference to spoilage (APC, PPC, Coliforms, enterobacteriacea) and pathogenic microbiota(S.aureus) and the microbiological counts found in these snacks were well below the laid down standards for dried meat products. Snacks from control samples (without soya flour) were less acceptable sensorially compared to soya pretreated ones.Storage stability of these further processed chicken snacks was more than a month at ambient temperature (30±2°C) with highly acceptable sensory quality.

4.37 Microbiological stability and sensory quality of tray dried chicken meat.

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A study was conducted to produce microbiologically safe dried chicken meat with optimum sensory quality characteristics. Fresh deboned chicken meat mixed with 2% salt and 1% spice mix was tray dried at 77.12°C for 6 hrs at 0, 2, 4, and 6 hrs intervals. Moisture, water activity, microbiological parameters analysed and sensory evaluation conducted at each interval during dried meat production. The moisture percent after 35.35 hrs of tray drying was 2.82%, water activity was 0.273 and sensorially the dried meat sample was highly acceptable and the colour of the meat was dark brown.

The microbial counts namely aerobic plate counts, psychrotrophs,coliforms, enterobacteriaceae, faecal streptococci, lactic acid bacteria, pseudomonas, proteolytic bacteria, Staphylococcus aureus and yeast and mould counts ranged log / g between 4.2 - 4.5 after 6 hours of drying.

4.38 Microbiological Stability and Sensory Quality of Sun Dried Chicken Meat

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A Study was carried out to produce microbiologically stable and sensorially acceptable sun dried chicken meat.Fresh chicken purchased from local market divided in to two lots of 1000 grams each.One lot mixed with salt (2.5%), turmeric powder (0.3%), pepper (0.3%), and spice mix (1.25%) served as a control without curry leaf powder and another lot treated with similar additives served as a treatment with 0.7% curry leaf powder. Both the samples were sundried at 29- 35°C for 6 hrs with intervals at 0, 2, 4, and 6 hrs for 8 days. Moisture content of control and treatment after 6 hrs of sun drying on day 8 was 11.90% and 11.02%, respectively.

While the protein was 65.99% and 65.00% for control and treatment, respectively, the ash content was 13.09% and 12.99% on day 8^{th} of sun drying, respectively. The water activity on day 8 was 0.479 and 0.483 for control and treatment, respectively whereas the water activity, on day 11for control and treatment was 0.419 and 0.412, respectively.

Both control and treatment were sensorially highly acceptable throughout 11 days of sun drying. Up to 4.0 log/g of APC, PPC, Coliforms, Enterobacteriaceae, Lactic acid bacteria, Faecal streptococci, Pseudomonas whereas a 4.7 log/cm^2 of yeast and mould counts recorded after 6 hours of sun drying on day 8 for these dried meat samples.Sensorially the samples treated with curry leaf powder were highly acceptable compared with control samples without curry leaf powder. However, curry leaf treated samples were dark grey in colour.

4.39 Effect of organic acids on microbiological safety and sensory quality of goat meat at refrigeration temperature.

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A study was carried out to find out the effects of organic acids on physical, microbiological and sensory parameters of goat meat during refrigerated storage. Fresh goat meat after 3-4 hrs of postmortem removed of fascia and connective tissue was subdivided in to four lots of each 1000 grams and one of the lots served as a control and remaining three lots were treated with 1% gluconic acid,1.5% gluconic acid, 2% propionic acid and 3% propionic acid and stored up to 14 days at refrigeration temperature. During refrigeration storage,pH, aW, ERV,WHC,bacterial counts analysed and sensory evaluation conducted at 0, 3, 5, 7, 9, 12 and 14 days.A 2% and 3% propionic acid treatment showed very low pH(4.91- 5.1)during 14 days of storage whereas 1% and 1.5% gluconic acid treatment exhibited high pH (5.89-6.6) up to day 9. Control ,1% and 1.5% gluconic acid treatments had 0.945 water activity on day 9 whereas on days 0,3,5,7,12 the aW was in the range of 0.951-0.978 for control and treatments.The ERV significantly increased throughout 14 days of storage in all treatments and control.However, 2 and 3% propionic acid treatments showed very high increases (64-81 ml) towards the end of 14 days of storage.WHC increases were more or less same throughout storage.

However, 2&3% propionic acid treatments maintained high (8.25- 9.25 ml) WHC up to 14 th day. More or less same increases were observed in aerobic plate counts in control and all treatments on days 0, 3, 5, 7, 9, 12 & 14.However, a 3% propionic acid treatment showed very low counts on day 3 & 9 and high counts on day 12 compared with rest of the treatment groups and control. A 3% propionic acid treatment showed very low PPC counts on day 0, &14 whereas 1% gluconic acid showed low counts on day 3.Both control and treatments showed low PPC on day 5 and on day 12, low PPC were observed for 1.5% gluconic acid,2% propionic acid and 3% propionic acid treatments. Low PPC were observed on day 12 in 1% gluconic acid treatment. Throughout 14 days of storage, there were increases in counts of pseudomonas in control and treatments.

However, on day 7,a 2% propionic acid and a 3% propionic acid samples showed very low counts of pseudomonas compared with 1% and 1.5% gluconic acid treatments whereas on day 9 samples treated with 1% & 3% propionic acid treatments. However, 3% propionic acid treated samples showed very high counts of pseudomonas on day 12.A 2 %and 3% propionic acid samples were highly sensorially acceptable up to 14 days whereas 1% and 1.5% gluconic acid samples were acceptable up to 9 days.

4.40 Detection of *Escherichia coli o157:h7, Salmonella spp.* and *Staphylococcus aureus* from mutton using multiplex polymerase chain reaction

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A study was conducted to establish a multiplex-PCR technique for rapid detection of *Escherichia coli O157:H7, Salmonella spp.* and *Staphylococcus aureus* from mutton.*six*gene, *invA* gene and *nuc* genes were targeted for *Escherichia coli O157:H7, Salmonella spp.* and *Staphylococcus aureus* respectively in the PCR reaction. Precision of this technique was found by sequencing the m-PCR products which were compared in BLAST and found to be 100%, 99% and 97% identical.

It was able to detect *Escherichia coli O157:H7* upto 3×10^4, *Salmonella spp.* upto 3×10^5 and *Staphylococcus aureus* upto 3×10^4 CFU/g of meat homogenate. 90 random mutton samples were collected from Chennai and m-PCR was carried out using these samples. All the samples were negative for *Escherichia coli O157:H7,* whereas, 9 samples were positive for *Salmonella spp.* and 15 samples were positive for *Staphylococcus aureus.* Hence, the study conclude that the m-PCR technique developed can be used as a rapid screening test for simultaneous detection of *Escherichia coli O157:H7, Salmonella spp.* and *Staphylococcus aureus* in mutton.

4.41 Effect of cooking, processing and freezing on concentration of DNA in beef and pork

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A study was conducted to identify effect of cooking, processing and freezing on beef and pork. Beef and Pork samples were subdivided into fresh samples (4+1°C), frozen samples (-18+2°C), cooked samples (pressure cooked at 6.8kg/cm^2 for 30 minutes) and processed samples. DNA extraction was done by chemical method, and also by real genomics DNA extraction kit method. OD values (indicator of purity of DNA) were found to be between 1.70 and 1.90 in all the samples of beef and pork utilized in this study.

Cooked and Processed meat samples constantly yielded higher concentration of DNA while frozen meat samples yielded lowest concentration of the three. The results of this study indicated that the freezing temperature has affected the concentration of DNA during the extraction process whereas cooking and processing at higher temperature did not affect the concentration of extractable DNA.

4.42 Detection of beef and pork using polymerase chain reaction

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A study was conducted to identify meat species, beef and pork in particular using Polymerase Chain Reaction. Beef and Pork samples were subdivided in to fresh (4+1°C), frozen (-18+2°C), cooked(pressure cooked at 6.8kg/cm^2 for 30 minutes) and processed samples. DNA extraction from beef and pork was done by chemical method, and also by real genomics DNA extraction kit method. Species-specific oligonucleotide primers based on sequences of mitochondrial 12S rRNA gene for beef and pork were custom made for Polymerase Chain Reaction. Species-Specific DNA fragments of 400 and 230 bp were successfully amplified with beef and pork primer sets respectively in 2 per cent agarose gel.

The sensitivity (detection limit) of PCR for beef was found to be 0.02ng/µl and the sensitivity (detection limit) of PCR for pork was found to be 1.5pg/µl. Direct sequencing of purified PCR products 12s rRNA gene of beef and pork samples were done and analysed using BLAST at NCBI and were found to be matching well. The results obtained in this study demonstrate the suitability of PCR analysis to identify the species of commercially available meat products which were subjected to intense heat treatments.

4.43 Detection of emerging food pathogens in chicken meat using multiplex Polymerase Chain Reaction

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A study was conducted to establish a multiplex-PCR technique for rapid detection of *Campylobacter jejuni* and *Listeria monocytogenes* from chicken meat. *Hyp* gene and *prfA* gene were targetted to detect *Campylobacter jejuni* and *Listeria monocytogenes* respectively, using PCR. Precision of this technique was determined from the sequenced m-PCR products compared in BLAST and found to be 99% identical with the known sequences available in the NIH-Gene Bank.

The developed m-PCR technique could detect both *Campylobacter jejuni* and *Listeria monocytogenes* upto 3×10^5 CFU/ml and 3×10^4 CFU/ml of meat homogenate. 90 chicken samples were collected from Chennai and m-PCR was carried out. All the samples screened were not positive for both Campylobacter jejuni and *Listeria monocytogenes*. Hence this study concluded with the fact that the m-PCR technique developed can be used as a rapid screening test for simultaneous detection of *Campylobacter jejuni* and *Listeria monocytogenes* from chicken meat within 24 hours.

4.44 Microbiological Quality of Chicken Meat Chips

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The study was conducted to assess the microbiological quality i.e. total plate and Yeast and mold counts of 4 Chicken meat chip formulations of raw and partially cooked meat extended with binders(15%) like cooked and mashed potato(T_1), bengal gram flour(T_2), black gram flour(T_3) and control(T_4). Irrespective of type of meat and type of formulation there is no significant effect on mean total plate and yeast and mold counts of chicken meat chips of fresh samples.

But the overall mean total plate and yeast and mold counts of chicken meat chips increased significantly and progressively($p<0.01$) as the storage period increased upto 8 weeks at both ambient (37 ± 2^0c) and refrigerated (7 ± 1^0c) conditions irrespective of type of meat and type of formulation.

4.45 Growth profiling of S*almonella typhimurium* isolated from poultry meat for assessment of its hardiness exposed to different temperatures

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A study was conducted to assess the effect of exposure of sublethal heat stress on growth and survivability of S*almonella* Typhimurium isolated from poultry with a view to assess its health hazard in temperature abused poultry meat. Culture of *S.* typhimurium (ST) grown at 30^0C to mid-log phase in fresh Luria Bertini broth was subjected to three different temperatures viz. 30^0C, 42^0C and 50^0C. The growth was assessed at different time intervals (0, 4, 8, 12, 16, 20, 24 h) by measuring the optical density.

The results of study indicated that subjecting *S.* Typhimurium at 30^0C and 42^0C temperatures, the growth pattern at all the intervals showed a increasing trend till end of the experiment, however, compare to 42^oC, the growth pattern was found to be higher at 30^oC. Subjecting *S.* Typhimurium to 50^0C temperature, the growth pattern indicated a decline trend even after 4 h which continued till the end of the experiment. The results of study related to assess the survivability of *S.* Typhimurium indicated that the organism survived even at 50^oC till end of the experiment.

Based on the results of the study it can be concluded that optimum temperature for growth for *S.* Typhimurium was 30^oC, however exposure of this organism at higher temperatures may lead to development of heat stress which can impart hardiness to this organism. Therefore, temperature abuse during storage of poultry meat at higher temperatures may serve a potential public health hazard for this organism.

4.46 Characterization of *Salmonella spp.* from live layer chicken and egg

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In Indian poultry industry, *Salmonellosis* is considered to be one of the most common food born disease causing huge economic loss for meat and poultry industry with public health importance. Raw poultry and meat products are reported to be the principle source of *Salmonella* in many countries but there is great need to test egg as a source of *Salmonella* as one of infectious agent for food born salmonellosis. By considering the importance the present study was undertaken to study prevalence of *Salmonella spp.* and also the characterization of *Salmonella spp.* along with antibiogram isolated from eggs from market conditions of Marathwada region of Maharashtra State. A total of 20 samples (40%) were positive for presence of *Salmonella spp.* out of the 50 egg samples and Only 2 (4%) were positive 0ut of 50 cloacal swabs collected from live layer birds. All the fields from where the egg samples were collected showed some proportion of positive samples ranging from 16.67% to 50%. All the *Salmonella* isolates confirmed to the various biochemical characters such as MR, VP, Indole, Nitrate, Catalase, Oxidase, Citrate and Urease tests.

For further confirmation the *Salmonella* isolates were subjected to sugar fermentation tests with glucose, rhamnose, arabinose, maltose, dulcitol, mannitol, lactose and sucrose. The results of sugar fermentation tests were in agreement with standards for Genus *Salmonella* of the various species. After performing the various biochemical and sugar tests mentioned earlier, isolates were sent to National *Salmonella* and *Escherchia* Centre (NSEC), Central Research Institute (CRI), Kasauli (Himachal Pradesh), India for serotyping. Out of the 9 *Salmonella* isolates obtained from eggs sent for serotyping 05 (55.56%) were identified as *Salmonella typhimurium* and 4 (44.44%) were identified as *Salmonella gallinarum.* The only isolate from cloacal swabs showed the presence of *Salmonella gallinarum.*

The low prevalence of *Salmonella spp*. in cloacal swabs in layer birds with that of prevalence from eggs helps to draw a conclusion that almost all the *Salmonella spp.* detected had the origin from unsanitary conditions in the premises, improper handling and unhygienic conditions of the shops. Further prevalence of *Salmonella spp.* from eggs and cloacal swabs of live layer birds was a surprisingly high as these *Salmonella* are invariably transmitted by transovarian route. High prevalence of *Salmonella spp*. in eggs indicates towards the alarming situation and need for corrective measures in the health aspect of layer birds as well as unhygienic conditions in the layer farms. The detection of *Salmonella typhimurium* in egg samples demands urgent attention of Veterinary and Public Health authorities as this serotype is reported to cause various disease conditions in humans.

4.47 Prevalence of Sallmonella spp. from meat market

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Foodborne diseases are the important growing public health and economic problem in many countries that too, *Salmonellosis* is one of the most common and widely distributed foodborne disease that originates from poultry. So present research project was under to study the prevalence, characterization and antibiogram of *Salmonella* spp. from broilers and broiler meat sold under market conditions in marathwada region of maharashtra state particularly from Parbhani city. Total 126 broiler meat sample and 50 cloacal swabs of live broiler birds were collected from different retail outlets and farms at different intervals over the period of eight months time, out of total 126 broiler meat samples, 26 samples (20.63%) were positive for presence of *Salmonella* spp. Only 2 (4%) were positive for presence of *Salmonella* spp. in cloacal swabs. All the *Salmonella* isolates confirmed to the various biochemical tests such as MR, VP, Indole, Nitrate, Catalase, Oxidase, Citrate and Urease as to the genus characters of *Salmonella* spp. Further confirmation of the *Salmonella* isolates was done by sugar fermentation tests with glucose, rhamnose, arabinose, maltose, dulcitol, mannitol, lactose and sucrose. The results of sugar fermentation test were in agreement with standards for Genus *Salmonella* of the various species. All the *Salmonella* isolates were subjected to antibiotic sensitivity test against 10 commonly used antibiotics. *Salmonella* isolates were most sensitive to ciprofloxacin (37.50%) followed by cefotaxim (31.25%), ceftriaxone (22.92%), gentamycin (10.42%), amikacin and chloramphenicol (6.25%), erythromycin, cefopime and enrofloxacin (04.17%) and oxytetracycline (02.08%). Among the intermediate sensitive. *Salmonella* isolates, toping in the list was gentamicin (72.92%) followed by ciprofloxacin (58.33%), amikacin, cefopime and cefotaxim (47.92%), enrofloxacin (44.67%), chloramphinicol (39.58%), ceftriaxone (35.42%), erythromycin (27.08%) and oxytetracycline (2.08%). Maximum (95.83%) *Salmonella* isolates were resistant to oxytetracycline. This was followed by erythromycin (72.92%), chloramphenicol and enrofloxacin (54.17%), cefopime (47.92%), amikacin (45.83%), ceftriaxone (41.67%), cefotaxime (20.83%), gentamicin (16.67%) and ciprofloxacin (04.17%).

The overall antibiotic sensitivity pattern indicates that ciprofloxacin was the most effective against the *Salmonella* isolates whereas maximum *Salmonella* isolates were resistant to oxytetracycline. The low prevalence of *Salmonella* spp. in cloacal swabs and high prevalence in broiler meat helps to draw a conclusion that almost all the *Salmonella* spp. detected from the broiler meat samples had the origin from unhygienic conditions of the shops and unsanitary conditions in the premises. Secondly, it can be opined that keeping the birds of different types including non-descript birds close to the dressing table might be adding to the contaminating *Salmonella* spp.

4.48 Characterization of *Staphylococcus spp*. from biofilms of broiler farms

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Biofilm is a serious threat to poultry industry environmental bacteria may enter into the poultry flock to produce disease outbreaks leading to heavy economic losses in commercial and breeder rearing farms in India. Therefore, it is important to know the prevalence and distribution of different bacterial flora in poultry environment. *Staphylococcus* is most commonly seen opportunistic organism in poultry environment and regarded as pathogenic to humans. By considering the importance the present study was undertaken to study prevalence of *Staphylococcus* spp. and characterization with antibiogram of isolates collected from biofilms of broiler farms in and around parbhani. A total of 160 samples were collected from Floor, wall, feeder, water trough and water supply network system. Overall prevalence of *Staphylococcus* spp. was 26.87% whereas *25% in floor,* 9.38% in *wall* and 31.25% in feeder, 46.88% in water trough and 21.88% *in* water supply network system. Total 43 *Staphylococcus* isolates were grown on selective medium such as Baired and Parkers agar, Mannitol salt agar, nutrient agar and MacConkey's agar. Biochemical characterization of *Staphylococcus* isolates was done by MR, VP, indole, nitrate test and for sugar fermentation tests various sugars viz. glucose, rhamnose, arabinose, maltose, dulcitol, mannitol, raffinose, xylose, inositol, lactose and sucrose were used.

The isolates of *Staphylococcus* spp. were subjected to various tests such as catalase, oxidase, citrate, hemolysis on 5%sheep blood agar, coagulase, gelatin liquification, phosphatase test, DNAse and urease test for detection of virulence characters. Out of 43 *Staphylococcus* spp. isolates, maximum numbers of isolates were identified as *S. aureus* (30) followed by S. *epidermidis* (9) and *S. intermedis (4*) depending on results of various tests. Out of 30 S. *aureus* identified the maximum (33.33 %) were obtained from water trough followed by feeders (23.33%), water supply network system (20%), floor (16.67%) and wall (6.67%). Out of the *S. epidermidis nine* isolates obtained maximum were from water trough (33.33%) which were followed by floor and feeder (22.22 %), wall and water supply network system(11.8%). Out of 4 isolates identified as *S. intermedis* maximum was from water trough (50%) followed by floor and feeders (25%). *S. intermedis* bacteria was not obtained from any of the samples of wall and water supply network system. Two phenotypic methods were used for detecting biofilm production in *Staphylococcus and Pseudomonas* isolates viz. Congo red agar test (CRA test) and Microtitre Plate assay (MTP assay). Out of total 43 samples processed 21 samples of *Staphylococcus* isolates were able to produce slime. Of the 21 isolates maximum (15) belonged to *S. aureus* followed by *S. epidermidis* (5) and *S. intermedis* (1). Regarding antibiogram, maximum (100%) sensitivity was shown to ciprofloxacin by all *Staphylococcus* isolates. Maximum resistance was observed in case of polymyxin B (69.76%). The data indicate that the biofilm of water trough and water supply network system were potential hosts for *Staphylococcus*spp.. The high prevalence *Staphylococcus* spp. in the water associated biofilm indicates that moisture plays an important role in establishment of biofilm as well as its capacity to harbor variety of pathogenic bacteria.

4.49 Characterization of *Pseudomonas spp*. from biofilms of broiler farms in and around Parbhani

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Biofilm is a serious threat to poultry industry and majority of poultry farms have biofilms problem due to lack of proper management. Biofilms harbor and protect pathogens and spoilaging microorganisms thus compromising sanitation standards leading to heavy losses in commercial and breeder rearing in India. Therefore, it is important to know the prevalence and distribution of different bacterial flora in poultry and its environment as many of them may be potentially pathogenic for poultry. *Pseudomonas is* most commonly seen opportunistic organism in poultry environment and having public health importance.

By considering the importance present research work was undertaken to study prevalence of *Pseudomonas* spp. and characterization along with antibiogram of isolates collected from biofilms of broiler farms. A total of 160 samples were collected from five different locations viz. Floor, wall, feeder, water trough and water supply network system and Prevalence of *Pseudomonas* spp. was 25% whereas 15.63% in floor, 6.25% in wall and in feeder each, 68.75% in water trough, and 28.13% in water supply network system. About 40 *Pseudomonas* isolates were grown on selective medium and Biochemical tests *viz* MR, VP, indole, nitrate test and tests for various sugar fermentation viz rhamnose, arabinose, inositol, dulcitol, mannitol, glucose, lactose and sucrose were carried out.

Furthermore for detection of virulence characters of *Pseudomonas* suspected isolates were subjected to various tests such as catalase, oxidase, citrate, hemolysis on 5% sheep blood agar, urease test, pyocynin and fluoresecin production on King's medium A and B. Depending on results of different tests, Out of the total 40 isolates of *Pseudomonas* spp. identified as maximum (30) of *P. aeruginosa* followed by *P. fluorescens (9)* and *P. putida (1*). Out of the supply network system (23.33%), floor (10%) wall and feeder (3.33%). Out of the 9 isolates of *P. fluorescens* obtained from various locations the maximum were from water trough (33.33%) followed by water supply network system and floor (22.22%), followed by wall andfeeder (11.11%). Only isolate of *P. putida* obtained was isolated from water trough. For detecting biofilm production, two phenotypic methods were used for *Pseudomonas* isolates viz. Congo red agar test (CRA test) and Microtitre Plate assay (MTP assay). Out of total 40 isolates subjected to CRA test, 19 samples showed ability of slime production.

The ability of slime production was highest in *P. aeruginosa* (50%) followed by *P. fluorescens* (44.44%). These results indicated that most of the bacteria isolated had ability to produce slime for further production of biofilm. Pseudomonas isolates were maximum resistance to Ampicilin and High sensitivity to Ciprofloxacin (95%) followed by Gentamicin (77.50%) and Enrofloxacin (70%). Form Present study it can be concluded that water supply network system is usually running through marshy and moist part of the land. The leakages were creating dampness near the water supply network system favoring the growth of *Pseudomonas* and other bacteria.

Thesebiofilms were probably established right from establishment of broiler farms and became thepotent source of pathogenic bacteria. *Pseudomonas* being a versatile bacteria,

localizes easily in biofilms whereby causing mortality and production losses. total 30 isolates of *P.aeruginosa* maximum were from water trough (60%) followed by water

4.50 Characterization of *Listeria* spp. from meat

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Listeriosis is one of the most important emerging zoonotic diseases causing higher rate of mortality in infected animals and human beings. The spread of listeriosis is mostly occurs through consumption of contaminated food and food products. Several outbreaks of the listeriosis were reported from all over the world. So far prevalence of *Listeria* spp. was not reported from Marathwada region of Maharashtra state. Keeping these points in view, present research project was planned with objectives, to study isolation and identification of *Listeria* spp. from meat, characterization of isolates and to study antibiogram of *Listeria* isolates. Out of total 150 meat samples only 6 % showed presence of *Listeria* spp each in chicken and beef. Out of isolates maximum 36.36% were confirmed as *Listera* grayi while 18.18 % each were of *L. monocytogenes, L. welshimeri and L. innocua.* 9.9% isolate of *L. seeligeri* was also recovered from poultry meat. All biochemically confirmed *Listeria* isolates were streaked on sheep blood agar (5 %) for observation of β hamolysis. Two *Listeria* isolates showing a broad, clear zone were confirmed as *L. monocytogenes* and the one isolate, showing a weak zone of haemolysis was confirmed as *L. seeligeri*. *In-vitro* antibiotic sensitivity spectrum of isolates of *Listeria* spp. recovered from meat samples was studied. Among the selected antibiotics, maximum numbers of isolates were sensitive to vancomycin (90.90%), followed by amikacin (72.72%) and amoxycillin (63.63%).

The isolates showed lesser sensitivity against enrofloxacin (45.45%), ampicillin and tetracycline (36.36%) each. *Listeria* isolates were least sensitive to the chloramphenicol and erythromycin (18.18 % each), followed by gentamicin (09.09 %). All the *Listeria* isolates recovered were resistant to penicillin-G. In the present study, *L. monocytogenes* isolates having zoonotic importance were found variably susceptible to the antibiotics tested. Both isolates of *L. monocytogenes* showed the highest sensitivity to vancomycin and amikacin (100 % each). Amoxycillin, ampicillin and enrofloxacin (50 % each) showed variable response against *L. monocytogenes*, while chloramphenicol, gentamicin and penicillin-G were found resistant. Taking into consideration of overall antibiotic sensitivity pattern showed by isolated *Listeria* spp. From beef and chicken meat samples, the present findings indicate the existence of multiple drug resistance among *L. monocytogenes* and other *Listeria* spp., which indicates the emergence of multiresistant *Listeria* strains, pointing to an increase in the potential threat to human health posed by this pathogen. Present findings of the research will be useful for field veterinarians and public health concerns.

4.51 Detection of major responsible sources of microbial contamination of retail poultry meat sold in Parbhani city

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In recent years poultry meat industry is becoming modern and hygienic. It happened only in case of the developed cities but in the semi-urban areas like Parbhani the poultry meat source is only from the retail poultry meat shops. The study was undertaken to detect major responsible sources of microbial contamination of retail poultry meat sold in Parbhani city. A total of 240 swab samples of different sources viz. knife, scalding tank, defeatherer, dressing table, platform, personnel, water and poultry meat were collected from five retail poultry meat shops in six lots.

The samples were subjected to microbial analysis to evaluate Total Viable Count (TVC), *E. coli* count and *Staphylococcal* count by using Plate Count Agar, Eosine Methylene Blue (EMB) agar and Baird Parker agar (BPA) respectively. TVC (log CFU/cm^2±SE) of dressing table and platform revealed (6.14±0.04) and (6.01±0.05) respectively found higher than other sources in retail poultry meat shops. Mean TVC of other sources in poultry meat shops were found as poultry meat (5.90±0.03), knife (5.85±0.05), defeatherer (5.89±0.06), personnel (5.74±0.06) and water (5.82±0.06). The mean TVC of scalding tank (5.67±0.05) was found lowest. Mean of *E. coli* counts and *Staphylococcal* counts of all sources were found 3.61±0.17 and 3.24±0.14 respectively. The results indicate that the dressing table used for making meat cuts and platform used for keeping poultry carcass are the major sources responsible for microbial contamination of retail poultry meat sold in Parbhani city.

MICROBIAL PROFILES OF EXPORT FROZEN BUFFALO MEAT TRIMMINGS AND SILVER SIDES

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To assess microbiological quality of buffalo meat trimmings and silver side, samples were collected from four different Indian export meat processing plants. The aim of this study was: (i) to evaluate standard plate (SPC), psychrotrophic (PTC), Enterococcus feacalis (EFC), Staphylococcus aureus and Escherichia coli count (ECC) and the presence of Salmonella spp. and Listeria monocytogenes; and (ii) also to determine vero-toxin producing E.coli (VTEC) by polymerase chain reaction (PCR). Trim samples had higher ($P<0.001$) SPC, PTC, EFC, and SAC than silver sides, there were no difference ($P>0.05$) across the sample types in ECC. However, E.coli was recovered from 32.4% trim and 19.5% silver side samples. The prevalence rate of Salmonella spp. was 1.75% in trimmings, whereas no silver side sample was found to be positive. L. monocytogenes recovered only from one trimming sample (0.87%).

The percentage of sample testing for positive for VTEC bearing vt_2 gene by PCR was only 2.58%. The finding suggest that trim sample contain higher microbes and only a few number of pathogens of latent zoonoses. So, maintenance of meat processing plants is of crucial importance. It can be measured in daily practice by slaughter process controls and regular microbiological monitoring of carcasses

TUBERCULOSIS - A RE-EMERGING ZOONOTIC THREAT

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Tuberculosis declared as global emergency a decade back by WHO, is one of the reemerging zoonotic threat having indirect but significant economic impact on meat sector. The present study was envisaged to know the magnitude of tuberculosis in cattle and animal attendants from slaughter house, and the efficacy of different test for detection of tuberculosis cases. A total of 200 samples (50 animal lung tissues, 50 animal sera, 50 human sputum and 50 human sera) were subjected to test adopting microscopic smear / histopathological examination cultural isolation and enzyme linked immuno sorbant assay. A microscopic smear revealed 24% of animal lungs and 36% of human sputum positive for Mycobacterium spp. while histopathological examination of animal lung tissues reflected a higher result with a figure of 28%. Culture isolation test of animal tissues, cultured on 2 different media. Stonebrink's and Lowenstein Jenson showed 18% and 10% positive cases respectively while the values for the same in human sputum was found to be 6% and 14% respectively. ELISA result for bovine and human sample shown 16% and 42% cases positive. Thus it was concluded that there exists a definite threat of zoonotic tuberculosis and regarding its examination microscopic smear/ histopathological examination have better sensitivity followed by indirect ELISA and culture isolation test.

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PREVALENCE OF LACTOBACILLUS SPECIES AND PLASMID CHARACTERIZATION FROM POULTRY MEAT AND MEAT PRODUCTS

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A total of 70 samples (50 from poultry meat & 20 from meat products) were processed for isolation & identification of Lactobacillus species. Out of 70 samples, 63 isolates were confirmed as Lactobacillus species. Out of 63 isolates, 43 were obtained from raw chicken meat and 20 from chicken products. Among 63 isolates, only 17 could be distinguished into different species of lactobacilli on the basis of bio-chemical characterization. MRS broth and MRS agar (pH 5.7 ± 0.2) was used as pre-enrichment and selective media respectively. The prevalence of Lactobacillus species was found to be 90 per cent. Among 63 isolates, four each were grouped as L. delbruckeii & L. salivarious; three were identified as L. fermentum; two isolates were belonging to each of L. gasseri and L.butchnerii whereas one each isolate was confirmed as L. acidophilus, L. plantarum, 46 lactobacilli could not be differentiated up to species level by bio-chemical characterization.

Out of 63 isolates, 27 isolates of Lactobacillus species (20 from poultry meat and seven from meat products) were processed for plasmid profile studies. Only six isolates confirmed presence of plasmid. All these plasmid bearing isolates (22.22 %) harboured single plasmid showing the molecular size ranging from 6.76 kb to 13.49 kb. Curing studies on these plasmid bearing lactobacilli with glycine, revealed elimination of furazolidone resistant plasmid from each of the isolate of L. delbruckeii, L. fermentum, L. salivarious and also from one unidentified species of Lactobacillus. The results reveal that glycine has a promising role in tackling passive transfer of drug resistance problem due to consumption of poultry meat and meat product against furazolidone group of drugs.