1. Name: Dr. M. MUTHUKUMAR

2. Academic qualification

Degree	**Institute/University**	**Year**
B.V.Sc.	Veterinary College and Research Institute, Namakkal, Tamil Nadu Veterinary and Animal Sciences University, Chennai	1996
M.V.Sc.	Madras Veterinary College, Tamil Nadu Veterinary and Animal Sciences University, Chennai	1998
Ph. D.	College of Veterinary Science, Hyderabad, Sri Venkateswara Veterinary University, Tirupati	2008
PGDBM	Madras Veterinary College, Tamil Nadu Veterinary and Animal Sciences University, Chennai	1997
PGD TMA	University of Hyderabad & NAARM	2013

3. Employment record

Position held	**Institution**	**Period of appointment (From–to)**	Nature of the duty
Senior Scientist (PB IV)	ICAR National Research Centre on Meat, Hyderabad	27.08.2015 to Till date	Research and development
Senior Scientist (PB III)	ICAR National Research Centre on Meat, Hyderabad	27.08.2012 to 26.08.2015	Research and development
Scientist (Senior scale)	ICAR National Research Centre on Meat, Hyderabad	27.08.2007 to 26.08.2012	Research and development
Scientist	ICAR National Research Centre on Meat, Hyderabad	27.08.2001 to 26.08.2007	Research and development
Veterinary and Quality Assurance Officer	Frigorifico Allana Ltd Aurangabad	05.10.1999 to 23.08.2001	Meat inspection and quality control
Veterinary Officer	Al Kabeer Exports Ltd, Hyderabad	06.02.1999 to 05.10.1999	Meat inspection

Projects handled:

Externally Funded Projects:				
Pl. or Co-Pl/	**Title of Project (s)**	**Year**	**Amount**	**Funding agency**

Associated Scientist			**In lakh**	
PI	Effect of buffaloes slaughter and meat export policy on livestock, milk, draught power and eco-balance in India	2014-17	47.00	Agricultural and Processed Food Products Export Development Authority (APEDA), New Delhi
Co-PI	Identification of species-specific peptide biomarkers using high-throughput proteomic approaches	2015-17	34.07	Dept. of Biotechnology, GoI
PI	Creation of awareness on clean meat production and value addition	2013-14	17.00	Dept. Animal Husbandry, Govt. Andhra Pradesh under RKVY
PI	Study on state-wise yield of meat and by-products of cattle, buffalo, goat, sheep, pig and poultry	2013-14	29.80	Ministry of Statistics & Programme Implementation, GoI, New Delhi
PI	ICAR Agribusiness Incubator	2015-17	79.15	ICAR, New Delhi
PI	ICAR National Agriculture Innovation fund (NAIF)	2016-17	6.40	ICAR, New Delhi

ii. Institutional projects

1. Studies on evaluation and improvement of fresh meat quality characteristics (Co Investigator)

The impact of slaughter weight and sexes on carcass traits (dressing yield and yield of meat and byproducts) and meat quality attributes (pH, water holding capacity, cooking yield, colour and nutritive value) of Nellore sheep and Deccan goat of Andhra Pradesh was studied.

2. Development of restructured pork products using unconventional binders (Principal Investigator)

The major objective of project was to develop pork products having better palatability, shelf life and making them available at affordable price to common meat eaters by incorporation of novel, cheaper non meat ingredients of plant origin viz., tapioca, sweet potato flour as binders/ extenders at appropriate level. The study revealed that acceptable quality pork blocks can be produced by incorporating tapioca flour up to 10% and sweet potato flour upto 7.5% and the product had a shelf life of about 15 days under refrigerated storage.

3. Economics, meat yield and quality of broilers grown to different live weights (Principal Investigator)

The yields of cut-up-parts, lean meat, fat, edible and inedible byproducts of broilers of different body weights procured from commercial broiler farms and retail markets were documented. Heavy weight group broiler (live weights of 2.5 kg and above) showed significantly better carcass traits (higher dressing percentage, yield percent of high valued primal cuts and total lean meat content), meat quality attributes (higher water holding capacity, redness value, shear force value,

protein and fat content) and nuggets prepared from heavy weight broiler revealed better overall palatability than light and medium group birds. The study indicates that meat processor could choose larger weight group birds, which yield leaner for preparing chicken meat based products more economically without affecting quality of the products.

4. Estimation of pesticide residues in poultry foods and feeds (Principal Investigator)

This project work involved establishing a baseline data on the levels of pesticide residues in poultry products like muscle (broiler and layer chicken), liver, fat, egg and feed and water samples collected from farms. In case of layer farm, a total of 125 samples including chicken muscle, liver, fat, feed, water samples were collected and processed for estimating pesticide residues. Overall 15.2 % of samples were showed presence of pesticide residues. Among the samples, feed (25 %) and fat (28.57 %) showed higher incidence of contamination. Among the pesticides, residues of endosulfan were more frequently observed. In case of broiler chicken, 196 samples, comprising water (16), feed (18), muscle (54), liver (54) and fat (54) were collected from three commercial broiler farms located near Hyderabad were analysed for assessing the level of pesticide residues. Overall 45.40 % of samples were showed presence of pesticide residues. Among the samples, feed (66.66 %) and fat (50.0 %) showed higher incidence of contamination. Among the pesticides, residues of HCH (99 samples), DDT (65), aldrin (34) and endosulfan (33) were more frequently observed. However, the levels of these pesticide residues were lower than the maximum residue limit prescribed by FSSA (2006).

5. Development of suitable packaging methods for meat and meat products (Co- Principal Investigator)

Quality and storage stability of chicken and mutton emulsion and different emulsion meat products cooked using dry, moist and frying methods were evaluated under aerobic and vacuum packaging conditions stored under refrigeration. Developed vacuum packaging methods for emulsion chicken products to enhance the shelf-life upto 40, 60 and 80 days for nuggets, patties and croquettes under refrigeration conditions. We have optimized the use of innovative super-chilling technology in combination with vacuum packaging for improving the storage life of fresh buffalo meat and mutton upto 3 months during storage at -1.0℃. The findings of this experiment are of great use to meat exporters. Standardized the gas composition for modified atmosphere packaging (MAP) of ground buffalo meat and mutton for improving the colour and lipid stability.

6. Estimation of pesticide residues in pond reared fishes from Kolleru region of AP (Co-Principal Investigator)

Baseline data on the levels of pesticide residues in the samples of fish, feed, water and soil collected from fish farms located in Kolleru region of West Godavari and Krishna districts were established. In total of 185 samples of fish (96), feed (27), water (31) and soil (31) collected from fish farms and analysed for the presence of pesticide residues. The results indicated that 81 fish samples contained pesticide residues. Similarly soil, water and feed samples also shown presence of pesticide residues. It is observed that all the pesticides compounds which were detected in fish, water, soil and feed samples were much below specified MRL (Food Safety and Standard Act, (2006) with few exceptions. Only residues of organochlorine compounds and synthetic pyrethroids were found in fish, water, soil and feed samples but organophosphorous compounds were not in detectable levels. There was a greater variation in the type and level of pesticides contamination observed between different locations.

7. Emu meat quality, processing and product development towards a niche market (Co-Principal Investigator)

In order to understand the emu meat as a potential red meat alternative, this need based research work was carried out with an objective to study the carcass characteristics, proximate composition, physico-chemical and microbial characteristics and sensory attributes of emu meat. The

study showed the potential of emu meat as a new source of low fat and quality meat proteins, however, more studies are required to elucidate the effect of age, sex, muscles, pre-slaughter and post-slaughter factors on different carcass and meat quality characteristics. The emu-chicken combination sausages under sous vide packing were stable at refrigeration temperature beyond 3 months relative to aerobic and vacuum packed samples which are stable for 20 and 90 days, respectively. The microbial load and lipid oxidation induced oxidation remained below the limit throughout the storage.

8. Studies on safety of muscle food based products with reference to carcinogenesis (Co-Principal Investigator)

The process for development of accelerated cured and smoked chicken and tilapia fish was standardized employing thumbing. The product developed by injection, tumbling and dipping in brine showed appealing colour than others and was chosen for further studies. The cured and smoked chicken legs packed under vacuum packaging and modified atmospheric packaging (100% nitrogen) was acceptable up to 30 days of refrigerated storage. The evaluation of quality attributes of tilapia fish prepared by accelerated curing revealed that the product is very well acceptable up to 20 days of refrigerated storage. Chicken meat products viz., tandoor chicken (3), chicken tikka (3) and smoked ckicken samples (4) were analysed for the presence of various polyaromatic hydrocarbons (PAH) by CG- MS/MS at NCML, Hyderabad. None of the chicken tikka samples showed presence of any PAH. Howere, 2 out 3 tandoor chicken showed presence of pyrene at 0.01 ppm level. The smoked chicken samples also showed the presence of PAH viz., pyrene and anthracene at 0.01 to 0.02 ppm level. More samples need to be screened for assessing the PAH residues level in processed meat products.

9. Development of healthier meat products enriched with omega-3 fatty acids and antioxidant intervention for improved shelf life (Principal Investigator)

Attempt was made to increase the level of omega 3 fatty acid in the chicken product by the addition of oils rich in omega 3 fatty acid. The replacement of 25 % of sun flower oil with flax seed oil did not result any significantly change in the physic-chemical, microbiological and sensory attributes except TBARS value. The nuggets made with flax seed oil have showed more oxidative rancidity than the control. However, incorporation of antioxidants viz. pomegranate phenol (30 ppm) and carnosic acid (150 ppm) had significantly retorted the oxidative rancidity in the flax seed oil incorporated nuggets. Analysis of the fatty acid profile revealed that significant increase (24%) in the levels of omega 3 fatty acid - linolenicacid (C18:3) in the chicken nuggets prepared with flax seed oil compared to control chicken nuggets made with 10% sun flower oil. Two entrepreneur training program on value added meat products were organized.

10. Estimating the levels of antibiotics residues in fish and poultry products (Co-Principal Investigator Poultry meat samples collected from markets in and around Hyderabad were screened for the presence of certain antibiotics viz., Fluoroquinolones (Nalidixic acid, Oxolonic acid), Sulphonamides (Sulphadiazine, sulphamethazine) and Tetracycline (Oxytetracyclines and chlor tetracycline).

Publications

1. **Muthukumar, M**., Naveena, B.M., Vaithiyanathan, S., Sen, A.R. and Sureshkumar. 2012. Effect of incorporation of *Moringa oleifera*leaves extract on colour, lipid oxidation and microbial quality of ground pork patties during refrigerated storage. Journal of Food Science and Technology 51 (11), 3172-3180.

2. **Muthukumar, M.,**Sudhakar Reddy, K., Kondal Reddy, K., Gopala Reddy, A., Jagdishwar Reddy, D., Kondaiah, N. and Narendra Reddy, C. 2011. Pesticides and heavy metals residues in pig tissues in Hyderabad. Indian Journal of Animal Sciences 81: 691-695.
3. **Muthukumar, M**., Sen, A.R., Naveena, B.M., Vaithiyanathan, S. and Girish Patil, S. 2011. Carcass traits and meat quality attributes of broilers grown to different body weights. Indian Journal of Animal Sciences 81: 615-620.
4. **Muthukumar, M**., Sudhakar Reddy, K., Narendra Reddy, C., Kondal Reddy, K., Gopala Reddy, A., Jagdishwar Reddy, D. and Kondaiah, N. 2010. Detection of Cyclodiene pesticide residues in buffalo meat and effect of cooking on residual level of endosulfan. Journal of Food Science and Technology 47(3): 325-329.
5. **Muthukumar, M.,**Naveena, B.M., Babji, Y. and Sen, A.R. 2006. Effect of slaughter weight and sex on carcass composition and meat quality of Nellore sheep breed. Indian Journal of Animal Sciences 76: 88-90.
6. Sen, A.R., Naveena, B.M., **Muthukumar, M.,** Babji, Y and Murthy, T.R.K. 2004. Effect of chilling, polyphosphates and bicarbonates on quality characteristics of broiler breast meat. British Poultry Science 46(4):4 51-456.
7. Naveena, B.M., **Muthukumar, M.,** Sen, A.R., Babji, Y. and Murthy, T.R.K. 2006. Improvement of shelf-life of buffalo meat steaks using lactic acid, clove oil and vitamin C during retail display. Meat Science 74: 409-415.
8. Vaithiyanathan S., B. M. Naveena, **M. Muthukumar**, P. S. Girish, C. Ramakrishna, A. R. Sen and Y. Babji. 2008. Biochemical and physicochemical changes in spent hen breast meat during postmortem aging. Poultry Science 87:180–186.
9. Naveena, B.M., Sen, A.R., **Muthukumar**, **M**., Babji, Y. and Kondaiah, N.2011. Effects of salt and ammonium hydroxide on the quality of ground buffalo meat. Meat Science, 87, 315–320.
10. Rajkumar, U., Muthukumar, M., Haunshi, S., Niranjan, M., Raju, MLVN., Rama Rao SV and Chatterjee, RN.2016. Comparative evaluation of carcass traits and meat quality in native Aseel chickens and commercial broilers. British Poultry Science. DOI: 10.1080/00071668.2016.1162282

Books

1. B.M. Naveena, **M. Muthukumar,** A.S.R. Anjaneyulu, A.R. Sen, & N. Kondaiah. 2011. Value added chicken products: an entrepreneur guide. Hind Publisher, Hyderabad. Pages: 109. ISBN: 978-81-921893-2-1.
2. Sen A.R., **Muthukumar, M.,** and Naveena B.M. 2013. Meat Science- A student guide. Satish Serial Publishing House, New Delhi. ISBN: 818930481X

3. **M.Muthukumar.** 2013. Quality attributes of electrical stimulated buffalo meat. Lambert publication. ISBN 978-3-659-45863-7.

4. Girish Patil, S., Kulkarni V.V, Sen, A.R. and **Muthukumar**, M. (2014). Animal Identification and *Meat Traceability: A Indian Perspective,* National Research Centre on Meat, Hyderaba

Videos

- Hyderabad Haleem: A Deccan Delight
- Chicken meat products processing

Significant achievements

Dr. M.Muthukumar has 2 years of experience in integrated export meat plants and 15 years of research, extension and teaching experience in meat science and technology. He has worked on 5 extramural projects sponsored by MoSPI, DBT, APEDA and ICAR and 11 institute projects. He is instrumental in establishing experimental abattoir, poultry processing unit, mobile exhibition unit, Agri-business incubation (ABI) centre, nutrients and chemical residues lab at NRC on Meat, Hyderabad. He played a key role in getting GI status to Hyderabad Haleem. He has 40 research articles to his credit and authored 4 books and prepared 2 videos. He was member of advisory committee of 6 postgraduate students of Livestock products technology. He is also serving as treasurer of Indian Meat Science Association and associate editor for Journal of Meat Science. He has organized two ICAR short course training and one DoE model training course, one National conference (IMSACON), one national workshop on traceability and several butchers and entrepreneurs trainings. As an officer in-charge for Institute technology management unit and ABI centre, he is actively involved in commercialization of technologies.