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Effect of Gamma Irradiation on Microbial Quality of Red and Poultry Meat Sold and Processed in Peshawar, Pakistan

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Abstract:

Meat is an important nutritional food item, essential for growth and maintenance of good health. The present work was carried out in Food Microbiology Department at Nuclear Institute of Food and Agriculture, Peshawar, KPK, Pakistan. Different samples of raw beef

and poultry meat were collected from local places to see the effect of irradiation on the quality of meat used to increase the shelf life of meat. The samples were packaged in sterile tetra bags. After collecting total samples half of them were exposed to gamma irradiation with dose of 2.5 and 5kGy, installed at Nuclear Institute of Food and Agriculture Peshawar, KPK, Pakistan. After analyzing total bacterial count, total coliforms count and total fungal count, the data revealed that low dose irradiated and un-irradiated sample were contaminated with enterobacteriacae and fungi. There was no growth observed at high dose irradiation. Hence the raw meat collected was unfit for health while the meat irradiated was free of microorganism and have more shelf life. It was found that meat sold in Peshawar city is highly contaminated in terms of microbes. This contamination in beef comes from soil during handling, floors and drains in the slaughterhouses. Thus to eradicate or eliminate this microbial contamination through proper handling and sanitation is not enough. We have to introduce, develop and apply the irradiation technology in slaughterhouses of the big cities in Pakistan.

Key words: Meat, Microbial contamination, Gamma Irradiation

Background:

Meat is an important nutritional food item, equally liked by man and other living organisms. Meat is essential for growth and maintenance of good health. Contamination in meat comes from external source during bleeding, handling and processing. The contaminating bacteria on the knives soon will be found in meat in various parts .The exterior of the animal harbors large number of microorganisms from soil and water. Microorganisms that contaminate the raw meat are *E. coli, salmonella pseudomonas* and *proteus*. Some other microorganisms include *Micrococcus, streptococcus* and *streptomycin* (Health *et al*. 2002).

Generally beef and poultry meat are consumed in Peshawar. Little or no effort has been made to monitor the

pollution of meat in Peshawar there are numerous centers of meat production and sale, which are located on the main city roads and thus the meat sold in Peshawar is not of desired quality. Keeping in view these problems it was considered essential to find safe method for decontamination of the meat, purposes, different chemicals have been in use but due to their health injurious residues there use been a banded in many countries. The research workers at the Massachusetts institute of technology who were pioneers in the radiation sterilization of food established during their early investigation that radiation doses are suitable for eradication microbes and extending their life (Ihsan *et al*. 2000).

Food irradiation (meat) is gaining acceptance worldwide and considered the technology of future. It is a process of exposing food to an ionizing energy to kill harmful microorganisms and extend shelf life of food. Food safety is a subject of growing importance to consumers, for reasons including the emergence of new types of harmful bacteria and evolving forms of older ones that can cause serious illness, scientists, regulators and law makers, working to determine how best to reduce the risk from food- borne illness are encouraging the use of technologies that can enhance the safety of our food supply. Many health experts agree that using a process called irradiation or cold pasteurization can be an effective way to eliminate many food born hazards and ensure that harmful organism are not in the foods we buy (Anon, 2000).

Gamma rays are more powerful than the rays emitted by a microwave oven. It has shorter wave length with higher frequency. It kills microorganisms, genetically altered so they can't produce. It takes lower doses to damage microorganism and insects than to alter enough molecules in the food to damage it.

Irradiation of meat and poultry does not increase human exposure to radiation since the energy used is not strong

enough to cause food to become radioactive. Irradiation of poultry and poultry products, including mechanically recovered meat, to reduce number of salmonella, Campylobacter and other food poising bacteria, doses up to3 kGy (fresh) and up to 7 kGy (frozen) have been recommended. Irradiation of red meat, including hamburger meat, to reduce number of Escherichia coli 0157:H7 and other food poising bacteria, doses of up to 4.5 kGy (fresh) and upto7 kGy have been recommended (Anon 2000).

Thus the present study was conducted to see the effect of irradiation on the quality of meat and to increase the shelf life of meat, sold in the Peshawar city which is the provincial capital of the Province Khyberpukhtunkhwa.

Materials and Methods:

The present work was carried out in Food Microbiology Department at Nuclear institute of Food and Agriculture, Peshawar, Khyberpukhtunkhwa, Pakistan.

Raw meat samples were taken from the butchers shops in Peshawar, in sterilized bags. They were chopped manually by sterilized knives, sealed with the help of vacuum sealing machine. The samples were irradiated through gamma rays at the doses of 2.5 and 5.0 kGy and stored at -18°C for a period of 40 days. They were analyzed initially and after each 10 days interval for total bacterial, total coliforms and total fungal counts. Some physicochemical tests were also applied for confirmation of faecal coliforms.

Preparation of saline solution and sample:

Saline solution was prepared by adding 8.5g sodium chloride in 1000 ml of distilled water. 9 ml of this solution was added to each test tube and plugged with cotton. 10 g of raw meat (both irradiated and unirradiated separately) was taken in a beaker having 100ml saline. Pour these into a sterilized bag and were

homogenized with the help of bag mixer for 2 minutes, further dilutions were made accordingly.

Preparation of plates:

Nutrient agar medium was used for the growth of total bacterial count. Nutrient agar (Merck Germany) at rate of 20g, per liter was prepared. For coli forms Maconkey agar (Merck Germany) at the rate of 14.5 g/liter was prepared. For fungi potato dextrose agar (Merck Germany) at rate of 14 g/liter was prepared. Media were auto claved at 121°C and 15 pound pressure /square inches for 15 minutes. After auto claving media was allowed to cool up to 45°C and placed in water bath for maintenance of media temperature sterile plastic plates of 20 × 90 mm were used for pouring. Petri dishes were marked with a marker for its diluent factors.

Inoculation:

20ml of sample was taken with the help of sterilize pipettes. 1ml was poured into the first marked Petri plate and 1ml was poured into the first normal saline test tube. Serial dilution method was followed further. After pouring sample 20ml media was poured into each Petri plate rotate the plates inside the laminar flow hood gently. The above procedure was followed for both control and irradiated meat. The plates were incubated at different temperatures 28$\pm$1°C and 45$\pm$1°C in incubators. After 24 hours of incubators growth was observed on the plates.

Physiochemical & Biochemical tests:

Gram staining was also performed for the identification of different bacterial groups. The Most Probable Number test was performed to determine the presence of coliforms in a given sample. For the determination of microbial species the bacterial cultures were grown on nutrient and Maconkey agar media. Biochemical tests (Indol, Methyl red and Urease) were

performed for confirmation of different bacteria (Cheesbrough 1995).

Results:

Data regarding the effect of irradiation on total bacterial counts in beef and poultry meat are presented in Tables 1 and 2. It was observed that the unirradiated samples were found highly contaminated with bacteria. The initial count was 2.3x102 which decreased to 1.9 x102 TBC/g of sample after storage of 40 days at -18 degrees C. Drastic reduction in microbial load was observed with increasing irradiation doses. The samples irradiated at the dose of 5.0 kGy, the bacterial growth was recorded to non-detectable level during the entire storage. Similar trend was observed in the samples of poultry meat. Both the samples (beef and poultry) were also analyzed for coliforms bacteria and the data are presented in Tables 3 & 4 respectively. The Coliforms counts in control samples ranged from 9.6×104 to 1x102cfu/g in beef and 2.3 x103 to 1.5 x 102 in poultry meat. It was further noted that the counts were drastically reduced by 2.5 kGy irradiation treated samples, while in the case of 5.0 kGy treated samples the counts were in the non detectable limits in both beef and poultry meat.

The data regarding the fungal analysis in beef and poultry are presented in Tables 5 and 6. It was observed that both the control beef and poultry samples were found slightly contaminated with mould. The 2.5 kGy treated samples showed decreasing trend in the development of fungi, while the fungal contamination in 5.0 kGy treated beef and poultry was in the non-detectable range.

The study further revealed that as the samples were stored in freezing condition, so the microbial load was decreased with increasing storage time in both the tested food materials.

Discussions:

Meat is an important nutritional food item, essential for growth and maintenance of good health. Fresh meat contain substances highly nutritious to microorganisms and high water content to ensure that they can develop and multiply in environment given suitable conditions. It is highly contaminated with the enterobacters. Contamination in ground beef comes from soil during handling, floors and drains in the slaughterhouses, contamination may come from knives, carts, boxes, from air and from personnel or other contaminated meat. Treating meat in slaughterhouses with irradiation technology can eliminate coliforms contamination. Irradiation is stream of swiftly moving particles firing out from radionuclide.

The process by which food is bombarded with high frequency energy capable of breaking chemical bonds of cell wall of the bacteria.. Irradiation source used for treatment of raw beef is implanted in Nuclear Institute of Food and Agriculture, Peshawar, Pakistan. We used irradiation doses 2.5 and 5.0 kGy that resulted elimination of enterobacteriacae and fungi.

Our results are in agreement with Clavero *et al.,* (1994) reported similar results by irradiation doses up to 3 kGy eliminated faecal coli form i.e. *Salmonella, E. coli* in beef. Result from a study by Heath *et al.,* (1990) also indicated that electron beam irradiation doses as low as 1kgy were effective in reducing *Salmonella* and aerobic bacteria in broiler thigh and breasts. Stiles and N.G, (1981) worked on Enterobacteriacae associated with meat and meat handling. They observed that meat is highly contaminated with faecal coli forms during slaughtering and handling process.

Thayer (1991) worked on use of irradiation to kill enteric pathogens on meat and poultry. The populations of most common enteric pathogens such as *Campylobacter jejuni*, *E. coli*

O157:H7, *Staphylococcus aureus, Salmonella* spp., *Listeria monocytogenes*, *and Aeromonas hydrophila* can be significantly decreased or eliminated by low-dose (< 3.0 kGy) treatments with ionizing radiation.

Vural *et al.* (2001) worked on low irradiation as a measure to improve microbiological quality of Turkish meat. The effect of low-dose gamma irradiation application on microbiological quality of raw meat ball was examined. In this study, 1, 2, and 3 kGy irradiation doses have decreased or eliminated the microorganism counts in raw meat ball, parallel with the increased doses.

Coliforms bacteria counts were reduced under detectable value after application of 2 kGy irradiation doses; *Staphylococcus aureus*, sulphite-reducing *Clostridia*, yeast and mould by the application of 3 kGy. It has been concluded that the low-dose gamma irradiation applications have increased the hygienic quality of raw meat balls and possible public health risks can be prevented.

Conclusion

Meat is an important nutritional food item, essential for growth and maintenance of good health. It was found that meat sold in Peshawar city is highly contaminated with the enterobacters and fungi. This contamination in beef comes from soil during handling, floors and drains in the slaughterhouses, contamination may come from knives, carts, boxes, from air and from personnel or other contaminated meat. Microbiological evaluation on meat irradiation suggests that the number of spoilage and pathogenic microorganism is greatly reduced in treated with absorbed doses of less than 10kgy. Irradiation of beef at less then10 kGy significantly reduces the number of spoilage organisms. For the eradication or elimination of microbial contamination from meat proper handling and sanitation are not enough we have to

introduce, develop and apply the irradiation technology in slaughterhouses of the big cities in Pakistan.

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ANNEXES

S.No	Treatments kGy	Storage days 0	10	20	30	40
1	Control	3.0x106	2.6x104	1.3x103	2.2x102	1.9x102
2	2.5	2.3x103	1.9x102	2.0 x102	1.6x102	8.6x101
3	5.0	ND	ND	ND	ND	ND

Table 1 Effect of irradiation on total bacterial count /g of beef
All the observations are mean of three values
ND=Not detected

S No	Treatments kGy	Storage days 0	10	20	30	40
1	Control	3.8x105	2.9x104	3.6x103	2.9x102	1.0 x102
2	2.5	1.5x102	1.0 x102	8.0 x101	6.7 x101	4.3 x101
3	5.0	ND	ND	ND	ND	ND

Table 2 Effect of irradiation on total bacterial count /g of poultry
All the observations are mean of three values
ND=Not detected

S No	Treatments kGy	Storage days 0	10	20	30	40
1	Control	9.6x104	8.2x103	6.2x102	3.2x102	1x102
2	2.5	6.8x102	2.3x102	1.6x102	9.8 x101	6.0 x101
3	5.0	ND	ND	ND	ND	ND

Table 3 Effect of irradiation on total coli form count /g of beef
All the observations are mean of three values
ND=Not detected

S No	Treatments kGy	Storage days 0	10	20	30	40
1	Control	2.3x103	2.5x102	1.2x102	2x102	150
2	2.5	2x102	120	90	62	31
3	5.0	ND	ND	ND	ND	ND

Table 4 Effect of irradiation on total coli form count / g of poultry
All the observations are mean of three values
ND=Not detected

S No	Treatments kGy	Storage days 0	10	20	30	40

1	Control	3.0x102	1.7x102	1.3 x102	1.1 x102	8.6 x101
2	2.5	10	8	5	2	0
3	5.0	ND	ND	ND	ND	ND

Table 5 Effect of irradiation on total fungal count /g of beef

All the observations are mean of three values

ND=Not detected

S No	Treatments kGy	Storage days				
		0	10	20	30	40
1	Control	1.0 x101	9.0 x101	5.0 x101	2.2 x101	4.2 x101
2	2.5	12	7	5	3	0
3	5.0	ND	ND	ND	ND	ND

Table 6 Effect of irradiation on total fungal count /g of poultry meat

All the observations are mean of three values

ND=Not detected