Studies on

Some Aspects of Diseases Transmitted Through Meat of Sheep And Goat With Special Reference To Zoonoses

THESIS

SUBMITTED TO THE AGRA UNIVERSITY IN PARTIAL FULFILMENT

OF THE REQUIREMENTS FOR THE AWARD OF DEGREE OF

MASTER OF VETERINARY SCIENCE

IN

MEDICINE

April, 1972

By

SUSHIL KUMAR DHAWAN

DEPARTMENT OF MEDICINE

U.P. COLLEGE OF VETERINARY SCIENCE AND ANIMAL HUSBANDRY

MATHURA, U.P.

CERTIFICATE

Certified that Sri SUSHIL KUMAR DHAWAN, a candidate for M.V.Sc. Final Examination of 1972, in Veterinary Medicine has been working under my supervision during the session and that the accompanying thesis entitled " STUDIES ON SOME ASPECTS OF DISEASES TRANSMITTED THROUGH MEAT OF SHEEP AND GOAT WITH SPECIAL REFERENCE TO ZOONOSES", which he is submitting is his genuine work.

Dated: April, 28, 1972.

(P. RAI)
M.V.Sc., Ph.D.
Professor & Head,
Department of Medicine,
U.P. College of Veterinary
Science & Animal Husbandry,
NAINIA

Professor of Medicine
U.P. College of Veterinary Science
and Animal Husbandry, Nainital.

The entire work embodied in this thesis was done under the grant of a Junior Research Fellowship by the Indian Council of Agricultural Research, New Delhi.

The author feels highly obliged for award of this honour and financial help rendered.

ACKNOWLEDGEMENT

Author wishes to express his extreme gratitude and indebtedness to Dr. P. Rai, M.V.Sc., Ph.D., Professor and Head, Department of Medicine, U.P. College of Veterinary Science and Animal Husbandry, Mathura, for his valuable and unparallel guidance, constant supervision and encouragement, constructive criticism and untiring labour for the preparation of this manuscript.

Thanks are also due to Sri D.P. Joshi, M.V.Sc, Assistant Professor of Preventive Medicine, all staff members of the Department of Medicine and my colleagues for their willing help and cooperation during the course of present investigation.

Acknowledgements are also due to Sri S. Ramaswamy, I.O.F.S. Manager, Sri T.N. Rawal, I.O.F.S. Deputy Manager (Laboratory) and Capt. G.S. Bali, R.V.C., A.P.D. Factory, Hazratpur (Bundla), Capt. K.B. Raj, Incharge A.F.C.C. Butchery, Mathura, Dr. V.P. Singh, Veterinary Officer, Bundla, Mr. Surender Singh, Veterinary Assistant Surgeon, Bundla (Hamirpur), for providing facilities and help during the work.

The author is extremely indebted to his parents, brothers, wife and children for their patience and encouragement.

In the last but not the least, thanks are due to the Principal, U.P. College of Veterinary Science & Animal Husbandry, Mathura for providing necessary facilities.

CONTENTS

INTRODUCTION

INTRODUCTION

Meat industry in contrast to most modern industries, has its roots in pre-historic times and basic procedure for processing meat had been well established by the dawn of recorded history.

Meat and its products provide an excellent source of protein in human nutrition, and in the present world scarcity of protein, makes it necessary to conserve and utilize meat supplies to the fullest possible extent. The fact that agricultural produce, alone, are quite insufficient to meet the nutritional requirements of a healthy body, the animal proteins have been included as a part of diet in all advanced countries. Demand of meat is progressively increasing, not only due to increase in the population, but also by fast changing food habits.

Great majority of animals slaughtered in all countries for human consumption consist of cattle, calves, sheep pigs and poultry, but in India buffaloes, goats and sheep are the main food animals (Marwaha, 1966).

The withdrawal of British troops in 1945 and migration of beef eating communities to Pakistan in 1947, alongwith the ban on cow slaughter in various states of India, enormous rise in prices of vegetables in comparison

to those of meat in recent years, has put an additional impetus on the increased production of mutton (Marketing Series 79, 1955).

It is estimated that the annual production of goat meat is 274 thousand metric tons, which indicates that goat is the principal meat producing animal in India.

The objective of meat inspection agency is manifold. It consists of a careful ante and post mortem inspection so that a disease free and wholesome meat may be available for human consumption. It also includes the supply of unadulterated properly labled meat from the meat industry. A meat hygiene system should thus include supervision of meat production chain from the farm through transport to well run abattoir and from there its distribution to the consumers. Such a system will not only result in a wholesome product for human consumption with improved keeping qualities, but will also make an important contribution to the control of livestock diseases. The application of principles of meat inspection, thus, can not be entrusted to non-skilled men employed in the abattoirs. Such persons are primarily concerned in the production problems, profits and other interests and are not always consistent with good practice of food handling. It is, therefore, imperative to have

meat inspection at all stages by skilled hand.

In India the congested inhabitation poverty, unhygienic association of animals and man, poor insanitary and unhealthy method of breeding, feeding and management of animals, roaming of pigs and dogs in the public places, eating garbage etc., all expose the animal kingdom to the risk of picking up and wide dissemination of infection (Annon, 1968).

Meat trade in India is in an unsatisfactory state, being completely in the hands of illiterate butchers. All the slaughter houses in municipalities are old, improperly equipped, ill maintained and do not provide even minimum required facilities for observing any hygienic conditions. Meat demand for vast rural population is largely met by these meat shops, where goats and sheep are slaughtered, dressed and unprocessed flesh (hot) is sold by the butchers, no ante or post mortem inspection is done. Nevertheless little public awareness exists as far as public health aspect of meat hygiene is concerned Marwaha loc.cit.). It is not uncommon to see large abattoirs without protective covering, containing only stone floors, gutters and few rudimentary racks to hang carcass (WHO monograph series 33, 1957). It is noteworthy that in certain countries which have relatively high hygienic standards and efficient reporting services, more than one

half of all outbreaks of food borne diseases are caused by meat and meat products. Such informations are scanty in India, although such outbreaks of diseases are not uncommon (Khera, 1968). Meat borne diseases have been classified as below (Meyer, 1953) which is now universally accepted (WHO Monograph 33).

1. Meat borne diseases of chemical or toxicological origin.

2. Endogenous (intravital) animal infection transmissible to man by meat.

3. Infections and intoxications due to exogenous (human and environmental) contamination of meat and manufactured meat products (bacterial food poisoning) (TABLE-I).

Keeping in view the above facts, the present investigations were undertaken to study the different diseased conditions of sheep and goat and their zoonosis. Attempt has also been made to study the logivity of hydated cyst under refrigeration, the infectivity of such cyst & Multiceps gaigeri in clean pups and guinea pigs. Microbial status of meat, different causative agents of abscess and histopathological studies of white spotted kidneys, were also studied under the present investigations.

Such studies, it is presumed, will be able to provide a clue to meat inspectors, for clean, hygienic and wholesome meat production for public consumption.

———:o:———

TABLE - I

MEAT BORNE DISEASES

DISEASES OF CHEMICAL/ TOXICOLOGICAL ORIGIN.

Tetradon poisoning from fish eating.

Haff disease, Fish borne (Acute alimentary myositis)

Paralytic shell fish poisoning

Meat from animals dead of Ergot poisoning

Chemicals (inorg. and organic)

GAINING EXCESS INTO MEAT ACCIDENTLY.

Thro'animals fed on cereal grown in naturally seleniferous or fluorotic soils

Thro' artificial additives which serve as fertilizers, soil conditioners, weed killers, insecticides or rodenticides.

Toxic chemicals added to meat as preservative(chemical preservative)

Metallic ions added thro' cooking utensils.

ENDOGENOUS (INTRAVITAL) ANIMAL INFECTIONS TRANSMISSIBLE TO MAN BY MEAT (ZOONOSES)

ACQUIRED THROUGH INTESTINAL TRACT

Pasteurellosis, Tularaemia, Leptospirosis, Listerellosis, Vibriosis, Ornithosis/Psittacosis, Foot & Mouth Fever, Insect borne, Encephalitis, Miscellaneous infections, Fascioliasis.

ACQUIRED OCCUPATIONALLY BY MEAT HANDLERS

Anthrax
Tuberculosis
Brucellosis
Salmonellosis

ACQUIRED THROUGH FOOD

Salmonellosis
Shigellosis
Trichinosis
Taeniasis
Echinococosis

INFECTIONS AND INTOXICATIONS DUE TO EXOGENOUS (HUMAN AND ENVIRONMENTAL)

Contaminants of meat and manufactured meat products

BACTERIAL FOOD POISONING.

Enterotoxigenic staphy.cocci

botulism

salmonellosis

Food borne viral infections

Poliomyelitis

Infectious hepatitis.

RARE MEAT BORNE ZOONOSES POSSIBLY BY INGESTION

Toxoplasmosis

Sarcosporidiosis

Intestinal myiasis.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The subject of meat inspection is a highly specialised job. In some conditions the meat is unfit for human consumption because there is fear of spread of various diseases while in some it is unsighty hence condemned. These conditions may be due to various diseases - parasitic, bacterial, viral, mycotic and others. A vast literature is available on these conditions, some of which are cited below.

Parasitic diseases

I. FASCIOLIASIS (Liver rot)

It is a common disease of sheep and goats caused by F. hepatica and F. gigantica, causes heavy loss due to condemnation of livers throughout the world.

Gruttner (1944) reported that liver fluke infection in animal predisposes to secondary bacterial infections including Salmonella.

Heydt (1952) suggested that heavily infected liver with liver flukes should be destroyed while those with light infection are fit for consumption, after boiling.

Kuhlmann (1956) demonstrated Salmonella in 23 out of 443 specimen of liver from cattle and sheep suffering from fascioliasis.

Burydon (1960) reported liver fluke as major cause of condemnation of sheep liver in New South Wales.

Sekulovic (1965) pointed out an incidence of 16.1 % in 126,832 sheep slaughtered in Grna Gora while Selvaraj (1967) reported an incidence of 4.42 % of fascioliasis in sheep and goat liver in Madras.

Mitchell (1968) reviewing meat borne zoonoses in East Africa, reported common occurrence of F. hepatica and F. gigantica with little difference in place distribution. In goats the throughout incidence recorded was 14 % but the condemnation rate of livers was between 37-46 %. Human fascioliasis has been recorded in several countries (Faust and Russell, 1957). The infection is normally acquired through eating cercaria contaminated water cress and lettuce. In some parts of Africa, goats liver is frequently eaten as raw causing pharyngeal infection in man. Since it is eaten raw in fresh condition the chances of infectivity are great as fasciola can not survive for long time after slaughter of the host.

In Britain in early 1969, 44 cases of Fasciola hepatica have been reported in man (mostly in 3 localities) while only 2 cases have been recorded during 1968 (Annon, 1969).

Bendezu (1969) recorded 60 % children in Central school suffering from F. hepatica. In other four villages with a total of 950 examinations, the incidence was found to be 2 %, 10 %, 15 % and 21 %. The infection is suspected to be picked up by children during play in ditches.

Yadav (1971) reported an incidence of 10.96 % in sheep and 8.2 % in goats of Mathura district.

II. HYDATIDOSIS

Hydatid cyst is a larval stage of Echinococcus granulosus (Batsch, 1786; Rudolphi, 1805).

Being cosmopolitan in distribution this larval stage of tape worm is an important public health and economic problem. The chain of infection that involves dog, sheep and goat is the major source of human echinococcosis. Smyth (1964) has reviewed the biology of hydatidosis.

Bugge (1944) during the course of many years experience of meat inspection, encountered many cases of sheep having echinocoecal cysts in the lungs. He also reported that in 3 % of these cases, cysts were also found in associated lymph nodes.

Ginsberg (1956) reported an incidence of hydatidosis in 1954 and 1955 as 23.7 % and 28.4 % in European sheep; 41.9 % and 53 % in African sheep; 18 % and 15.2 % in African goats respectively.

Gemmell (1958) reported an incidence of 11.6 % (3,74,165) in sheep in Australia and felt that the incidence was more in adults.

Gemmell (1959) found a high incidence of this disease in different parts of Australia. In man 2-6 persons per 10,000 of the rural population were found to harbour hydatid cyst in the lungs.

Gabriel (1957) reported one case of hydatid cyst in the liver of an Indian Tamil living in Ceylon for the last 20 years.

Paul (1957) described a case of hydatid disease (cyst in liver) in a South Indian woman residing in Ceylon.

Paul et al. (1957) reported 6 human cases of hydatid disease admitted to general hospital Colombo in past 30 years (all were Indian).

Gemmell (1961a) reported significant increase in the incidence with the increasing age. (in lamb 3 %; in old sheep 90 %). Lung and liver were equally involved; irrespective of number of cysts harboured by the animal.

Gemmell (1961a) also reported that early infestation of the eggs of E. granulosus does not produce relative immunity against later infestation as is in case of T. hydatigena (Sweatman, 1957).

Sayed et al. (1962) reported a case of hydatid disease of kidney in a human female in India who complained for fullness and vagine abdominal pain in right loin.

Smyth (1964) mentioned that Jubb and Kennedy (1963) report that sheep is the only normal intermediate host of T. echinococcus.

Abdon (1965) reported hydatidosis in sheep to be 5 %. No accurate figure is available for hydatid disease in man.

Mc Cristell (1966) reported that since the start of compaign of eradication of hydatidosis in Newzealand in 1959, the incidence of E. granulosus in dogs have declined from 5 % to under 1 % and T. hydatigena from 13 % to about 5 % but the incidence of T. ovis has risen steadily from 1 % to about 3 %.

Prakash et al. (1967) reported an incidence of 9.5 % (240 sheep) and 9.8 % (294 goats) in Delhi. He also reported that 96 patients with hydatid disease were admitted in two hospitals in Delhi from 1962-1965 (3 per 10,000 admissions from all cases).

Selvaraj (1967) states that most conspicuous persistant condition in the liver of sheep (39.8 %) and goat (16.0 %) were hydatidosis.

Singh et al. (1969) reported from Patna (Bihar) 3.1 % infestation in 2546 goat livers examined, 75 % of the cysts were fertile.

Pandey (1971) reported an incidence of 6.5 % (0.33 in young and 8.0 in adults) in goats; fertility 77.7 %; organs infected were lung, liver and spleen. Number of cysts were more in lung than liver and spleen.

Yadav (1971) recorded 3.81 % of 708 goats and 4.1 % of 73 sheep with 72-75 % fertile cysts in the district of Mathura in U.P.

III. Cysticercus tenuicollis and Cysticercus ovis.

It is cosmopolitan in distribution, and found in the peritoneal cavity of food animals particularly sheep. The mild infections do not cause pathogenesis but in heavy infections haemorrhagic hepatitis associated with circumscribed or diffused peritonitis is met with - a condition known as Hepatitis cysticercosa (Soulsby, 1965; Deorani, 1967). An association between migrating Cysticercus taenicollis and black disease is reported by Turner, 1930.

Schmey et al.(1931) discussed the vitality of Cysticercus cyst after freezing and found that 4 days freezing at-8°C to -10°C kills the cyst but the market value of meat is greatly reduced.

Collins (1939) reported the incidence of C. tenuicollis more common in lambs and occasionally extremely heavy infections are found. One-third of ovine liver is condemned because of damage by the burrowing of pre-scolex stage of this parasite.

Brydon (1960) reported that major cause of condemnation of meat in sheep in Australia in 1959 was C. tenuicollis and liver fluke.

Deodhar et al. (1968) described a case of Pneumonitis cysticercosa in goat.

Yadav (1971) reported an incidence of 5.65 % of 708 goats and 8.2 % of 73 sheep.

IV. Coenurus gaigeri

Intermediate stage of Multiceps gaigeri or Taenia gaigeri (Hall, 1916).

Coenurus may occur in the central nervous system, the intermuscular connective tissue, the abdominal cavity, thoracic sheath and pericardial sheath of intermediate host

goat (Southwell, 1930; Wardle et al., 1952).

The species is identified by the presence of large hooks (Clapham, 1942).

Coenurus has been reported in heart (Singh et al., 1971), diaphragm, base of ear and thigh muscle (Rao, 1971), kidney and brain (Paliwal et al., 1971).

Its importance is recognized economically.

V. TOXOPLASMOSIS

A protozoa, parasitize a wide range of mammals and birds, including human beings.

Beverley (1960) described probability of congenital infection of toxoplasmosis in man alongwith its pathogenesis.

Garnham et al. (1960) ascribed sheep as potential reservoir of Toxoplasma in man and revealed that in experimental infection the organism persisted in low density in the brain, skeltal and heart muscles, liver and kidneys. He found that under cooking of meat killed the organism, thus the possibility of infection by eating infected meat was ruled out.

Fukazawa et al.(1964) described heat resistance of Toxoplasma in meat and explained that in liver and muscle it is not infective to mice after 1 day at -10°C or below but the cyst in brain were still infective after 2 days at -10°C. Both naturally and artificially infected material were infective after 50°C for 5 minutes but not after 55°C for 5 minutes.

Several workers have shown the possibility of its infection through meat Eichenwald (1948), Weinman et al. (1954), Mayer (1962). In France alone the positive titre has been as high as 80-93 % in people eating raw uncooked meat.

Miscellaneous

Fusthy (1938) described 3 cases of Balantidiosis in Hungary. One woman exhibiting infection was engaged in triple cleaning and had gastric hypoacidity.

Heyden et al.(1939) reported a case of Trichostrongylus columbiformis infection in a child thought to have acquired from goats.

Purdy (1955) described lesions of orf on the back of hand of a stock avetioner, who apparently became infected by handling sheep with pustular dermatitis.

Khanna et al. (1971) reported a case of Nosema cuniculi infection in a goat by finding the schizont stage in the tubules of goat kidney in the course of his working for leptospiral isolation in the white spotted kidneys.

Bacteriology of Meat and Bacterial Contaminants

Micro-organisms are present on the skin and hair, natural openings and cavities of the living animals. Thus the alimentary tract, nasopharyngeal cavities and external position of urinogenital tract harbour a characteristic bacterial flora which are adapted to the environment. On the other hand those tissues and cavities which have no direct connection with the exterior are sterile in healthy and normal animal. Organisms are not present in the blood stream, bone marrow, lymph nodes or the thoracic or abdominal cavities including the lung, liver and spleen. The organisms easily spoil and decompose meat often leading to food poisoning.

This type of study has been made by a number of workers. Haines (1932), Empey et al. (1933), Lock head et al. (1935), Empey et al. (1939a), Jensen et al. (1941), Ayres et al. (1950), Kirsch et al. (1952), Ayres (1955), Brown et al (1958), Stringer et al. (1969), Rao (1970).

Verge (1931) explained the importance of bacteriological examination of meat. In number of cases, the animal had died or had been slaughtered during illness. The carcass shows no indication of disease. Cases of latent pyaemia or septicaemic condition were present.

Hubner (1932) during the post mortem examination at Barlin abattoir attributed green discolouration of flesh or body organs due to local increase in eosinophilic leucocytes in Cysticercosis, Sarcosporidiasis in muscles, dead echinococcus cysts, C. tenvicollis, liver flukes in liver and lungs.

Haines (1932a) found air, water used in washing and rinsing of carcass, clothes and brushes used for wiping and carcass tools and also the hands of workmen as the principal source of contamination.

Verge et al. (1932) stressed the need of identification of pathogenic microorganisms of human importance and their quick method. Invasion and development of bacteria are influenced by the physiological condition of the animal before slaughter (Haines, 1937).

Jensen et al. (1941) stated that the contamination is possible due to stick knife as the skin of the animal is heavily contaminated. They placed pure bacterial culture on the blade of knife just prior to sticking and used this

instrument to severe the neck of the animal; they found the specific bacteria introduced could be isolated from marrow of long bones.

Prokhorov (1941) examined 163 mutton samples during 1938-39 and found Salmonella in 3 %, B. coli in 24 % and Cocci in 20.2 %.

Stara (1943) identified Bacillus, Clostridia, Salmonella, Eberthella, Escherichia, Proteus, Streptococcus, Staphylococcus, Corynebacterium, Diplococcus and Aerobacter in meat and their products.

Lapovetsky (1953) while examining the carcass for bacterial flora, could isolate anaerobic, thermophilic organisms responsible for spoiling the meat quality. Their presence in lymph nodes gives a clue for internal spoilage.

Ayres (1955) felt that there is a definite relation in the microbial contamination with handling, slaughtering and dressing time of meat animals.

Kolobolotski (1956) described a method of determination of bacterial toxins in meat by oxidising colour reaction. Similar tests were done by Sedov (1966).

Heidrich (1963) felt that there is no material difference in tetrathionate broth and selenite broth used for demonstration of Salmonella.

Lawrie (1966) described physiological condition of animal before slaughter, method of slaughtering, bleeding and cutting, contamination through alimentary canal of animal, addition of organisms through the equipment, workers hands and clothes and temperature at which meat is aged or stored are the factors responsible for condemnation of meat due to spoilage.

Rao (1970) worked on the bacteriological quality of comminuted meat and found that the meat was contaminated after slaughter which was observed by difference in the bacterial count.

Bacterial food poisoning is described to be of two types - a. infective type due to the presence of Salmonella and b. toxic type due to presence of toxins.

Salmonellosis

The most direct route by which Salmonella can be conveyed from animals to man is through the consumption of animal food (WHO monograph 33, 1957).

Animal Salmonellosis is quite wide-spread in this country and almost all species of domestic animals have been found to suffer from this disease (Khera, 1962). There are numerous reports of sporodic cases and outbreaks of disease due to Salmonella infection in human beings

(Hayes et al. (1945); Gangulí (1958); Agarwal (1963); Nath et al. (1966).

There is great deal of information showing not only an apparent increase in the incidence of Salmonella food poisoning in man, but also a relationship between the incidence of Salmonella in man and in food animals. The incidence is towards increase. In England and Wales there has been an expansion in number of cases during recent years. It is not clear whether it is real or is due to the improvised technique for isolation and identification of organism (Galtan et al., 1954).

Lachenschmid (1931) gave an account of paratyphoid cases due to meat poisoning in Germany which increased from 821 in 1929 to 925 in 1930. He felt that efficient veterinary inspection of meat and meat products could quickly reduce the incidence of disease in man.

Klimmeck (1937) reported a case of meat poisoning due to S. typhimurium caused by a wholesome carcass which was hung by the side of unfit carcass.

Niclas (1937) examined 500 animals before and after slaughter at Dortmund abattoir. S. typhimurium was found in four carcasses whence portal and mesenteric lymph nodes were examined and it was considered that latent Salmonella infection may exhibit in food animals looking healthy.

Bortel (1939) explained pathogenesis of Salmonella typhimurium, S. enteritidis and its variants. It is pointed out that the symptoms of food poisoning produced are not associated with a septicaemia, as in infection with Salmonella which cause typhoid and paratyphoid fever. The actual pathogenesis is not clear but experiments showed that the above organisms have toxic fraction which is also present in dead bacteria and the toxic material liberated after death of bacteria is diminished under the influence of stomach contents of laboratory animals and not by the stomach contents of man. It is assumed that in man the bacteria taken in with the food are largely killed by the acid of the stomach and that the toxic fraction is liberated and absorbed by the intestinal mucosa thus producing symptoms associated with food poisoning.

Baars (1941) declared that Salmonella food poisoning is due to the harmful effects of the organisms themselves and not due to the toxin liberated by them.

Outbreaks of food poisonings in man have been reported due to S. ayatum by Peter (1944); S. berta by Hanser et al. (1945); S. dublin by Jones et al. (1948); S. enteritidis var dublin and S. thomas by Geurden et al. (1949); S. typhimurium by Meyer (1950); S. morehead by Gangull et al (1956); S. weltevreden by Mathur (1959);

S. heidelberg by Sen Gupta et al. (1961); S. typhimurium by Bhatia et al. (1968).

Cordes (1949) explained that artificially infected pieces of meat were sterile after exposure to water at 100°C for 60 minutes.

Savage (1956) has expressed problems of Salmonella food poisoning in Great Britain which is on an increase. He felt that the hazards of food poisoning are on an increase due to change in eating habits of the population.

Merle (1958) was of the opinion that contamination of food often takes place after it has left the abattoir.

Thornton (1958) discussed the importance of examination of popliteal and preseapale lymph nodes for Salmonellosis.

Artioli (1959) stated that many outbreaks alleged due to meat are due to other factors as for Salmonella, the incubation period is never less than 5 - 72 hours with an average of 12 - 24 hours; no thermal resistant toxin is produced and disease can only be caused by the ingestion of living organism.

Hobbs et al. (1959) isolated Salmonella from 105 out of 1194 samples of different varieties of meat during three years.

Smith (1964) during the course of his survey in 1961 and 1962 felt that meat and meat products were the most common source of Salmonella food poisoning. Mutton is not so common source as pork, beaf and veal.

Sethi et al. (1968) investigated Salmonella organism in sheep in health and diseased condition and found to excrete Salmonella in their faeces.

Pandurangarao (1968) reported heavy mortality among lambs in Jammu due to S. typhimurium. Since mutton is commonly used as human food in this country, such a finding is of great significance from public health point of view.

Food Intoxifations

Certain stains of Staphylococcus produce a filtrate enterotoxin in meat especially when the temperature is worm enough. This type of toxin is common and symptoms appear within 2-5 hours after ingestion of the infected food.

Stone (1938) described method of identification of Staphylococci causing food poisoning in man.

Minett (1938) found kitten as the best experimental animal for such trial. He further observed that Staphylococci toxin are resistant at 95^{o}C after 30 minutes, hemolytic

toxin is destroyed by low concentration of formalin, rennet and acid (pH 5.0) also destroy it but trypsin has better action.

Rigdon (1938) described the properties of Staphylococcal toxin.

Blair (1939) stated that exotoxin is thermolebile at 55-60^{o}C and also sensitive to light and oxidation.

Scott et al. (1943) reported outbreak due to Staphylococcal toxin by eating boiled meat.

Dolman (1943) believed Staphylococci to be responsible for food poisoning in majority of cases. The symptoms resemble to toxin of B type, but is differentiated on the basis of pathogenicity on volunteers. He also attributed majority of cases due to enterotoxaemia which could not be detected at the time of examination as they were masked.

Kampe (1945) also reported this type of poisoning in two cases.

Moorehead et al. (1946) was of the opinion that house fly (musca domestica) does play a definite role in the spread of staphylococcal food poisoning.

While testing thermal death time of strains of

Staphylococcus Gross et al. (1947) found that the complete destruction of organism was not only a factor of time and temperature but was markedly influenced by many other factors such as number of organism present, age of culture and nature of meat medium. He further observed that curing agents greatly increase the thermal resistance.

Allison et al. (1949) described an outbreak of Staphylococcal poisoning in 141 cases of cooked meat.

Artioli (1959) could not find evidence of entero-toxin production in fresh meat by Staphylococcus aireus but was able to do so in boiled or smoked meat. He claimed acute gastroenteritis caused by meat of any description to be rare.

D'Souza et al. (1965) explained that since the toxin in Staphylococcus is already present at the time of ingestion, it does not require incubation period as against Salmonella where the toxin is produced after ingestion.

Clostridium Perfringens (Welchii).

This anaerobic organism though known since 1895 to be present in faeces of man and animal, could gain its importance as a causative agent of food poisoning during Second World War (WHO : 1957). This organism survives the

ordinary cooking and its spore grow easily when favourable circumstances appear.

Esty et al. (1922) found that Sodium chloride in low concentration (0.5 - 1 %) markedly increased the thermal resistance of spores of Clostridium botulinum. At 2 % this effect is lost, upto 8 % little or no effect was observed and above this amount upto 20 % thermal death time is decreased.

Schoof et al. (1938) detected an aerobes in descending order in liver, kidney, spleen and muscles and found sheep to be commonly affected than animals, and advocated condemnation of affected meat.

Jones (1951) reported food poisoning from meat in school children due to clostridium welchii type 6.

Hobbs et al. (1959) isolated Clostridium welchii from 79 samples out of 915 samples of different varieties of meat in three years.

Narayan (1967) isolated Clostridial organisms from extensor and flexor muscles of fore and hind limbs, prescapular lymph glands, from ileocaecal region, liver, spleen and kidney of 20 sheep and reported highest incidence in poultry (100 %) and lowest in sheep (65 %).

Sinha et al. (1969) isolated 39 strains of Clostridium welchii belonging to type A.B.D. and non-toxic type from 102 apparently healthy goats. Spores of two strains were found to be resistant at boiling temperature for one hour.

Bacterial zoonoses

Brucellosis caused by Brucella sp. is a widely distributed disease of farm animals communicable to man chiefly through milk and meat handling.

Serological evidence of brucella infection in food animals have been reported by a number of workers, Polding (1948), Army Remount and Veterinary Service (1962), Murty (1962), Mathur (1964) and Sen et al. (1968).

Occasional reports of outbreaks in some families have been reported by Mathur et al. (1959a, 1959b).

Levine (1943) reported brucella infection in meat packing factory workers, who were in habit of surreptitiously eating offals and partially cooked meat, though they did not touch the meat.

Mundt (1956) reported that meat should be subjected to bacteriological meat examination and that wool be regarded as potential source of brucella infection.

Kurzejak (1957) reported 5.5 % positive cases in 1351 people out of which 14 were clinical (all veterinary personnel). Higher reactors 31 of 199 (15.5 %) were among veterinary personnel. In meat industry the incidence was 3.4 %.

Sumna et al. (1957) reported that five employees of an abattoir developed brucellosis shortly after the slaughter of 400 infected sheep.

Leistner (1960) isolated brucella 9 times from lymph nodes, 7 times from organs, 4 and 3 times from muscles of 54 slaughtered food animals positive serologically for brucella.

Siennicki et al. (1960) reported 7 out of 1615 meat workers as serologically positive reactors for brucella with clinical symptoms in two cases.

Kosilov et al. (1962) ascribed survival of brucella organism in mutton. He established artificial infection in 8 sheep and after slaughter split them in two. Left side was placed in -9 to 11°C while right side at 2 - 4°C. Samples of 7 lymph nodes and 3 muscles were collected after 6 hours, 9 - 10 hours, after slaughter and examined for brucella by culture and guinea pig innoculated. Left side was sampled after 3 months.

Brucella was recovered from lymph nodes of 7 sheeps, 6 hours after slaughter, 3 after 9-10 days refrigeration and from 2 in deep frozen sides. Organism was not recovered from muscles.

Randhawa et al. (1964) believed that goat is the most dangerous source of brucellosis for human beings. According to them, these animals assume chronic form without showing symptoms. They further emphasized that when meat is thoroughly cooked before eating, this infection is rare. It is mostly the raw or fresh meat that can possibly cause this hazard. However with changing eating habits, processed meat is also likely to become equally important.

Mathur (1968) during the course of his investigation in Haryana province found that cows and buffaloes were not the source of human infection but attributed sheep and goats as main source of infection which was confined by the fact that 29 out of 53 patients were sheep and goat keepers.

Randhawa et al (1970) found that infected meat is able to transmit the disease.

Joshi et al. (1971) declared that brucellosos is more or less an occupational disease affecting veterinarians, dairy workers, abattoir workers and others who handle animals.

Tuberculosis

It is now universally accepted that the man and other animal species are infected with one of the three types of tubercule bacillis. Even slightly infected meat and meat products are unfit for consumption (WHO 33, 1957).

Selter et al. (1937) isolated tubercle bacilli from apparently healthy organs (lung, liver, spleen and kidney).

Trawinski (1937) reported incidence of tuberculosis in slaughtered sheep and goat in Poland as 1.08 (385,889 sheep and 17,332 goats examined).

Saenz et al. (1938) isolated bovine type bacillus from lesions on the hands of two butchers who had received cuts while handling the carcasses.

Rocher et al. (1938) isolated bovine type bacillus in 2 human cases out of 89 with positive results.

Grok et al. (1939) reported 49 cases of renal tuberculosis and four cases of tuberculosis of testicle and epididymus. 43.4 % were typed as bovine type and others were mixed bovine and human type.

Grok (1939) isolated human type infection in 25 tuberculous cattle.

Petri (1940) reported 4.9 % tuberculosis in goats slaughtered at Frankfort on main. The commonest site being lung followed by liver, spleen, intestine, kidney, udder, bones, pleura, meninges and lymph nodes of head and trunk.

Krishna Iyer (1940) stated that tuberculosis is rare in sheep and goat.

Cohrs (1941) felt that simultaneous presence of tuberculous lesions in the lungs and kidney be regarded as proof of haematogenous distribution of the bacilli. In sheep and goat acute haematogenous miliary tuberculosis usually develop during early stage.

Spencer (1942) gave an account of number of cases met within practice where tuberculosis in man apparently resulted from the ingestion of uncooked meat, two cases of pharyngeal or laryngeal tuberculosis were recorded in natives which were associated with uncooked or imperfectly cooked goat's meat.

Cohrs (1943) contradicting the provision of law for inspecting whole carcass during miliary tuberculosis of lung and kidney felt that it does not include cases of generalized tuberculosis with no visible lesions. The bacilli may be held in the blood circulating in the muscles and in the muscular tissue but can not develop there. They

can not be demonstrated in the blood during life but may be present in the heart blood after death; it is suggested that they pass into blood stream during extreme pain.

Lilleenger (1946) described contamination after slaughter. He found that an average of 71 % of utensils and 100 % of wiping clothes were contaminated. In 68 % of cases the tubercle bacilli could be isolated from the floor after cold water sluicing. Contamination of carcass may be caused by exudate flowing over the surface or caseous material being spread by saws used to cut lesions of infected carcass; by floor scrapings touching the infected carcasses and by contaminated hands of the operators.

Klein et al. (1958) stressed the need of examining lymph nodes during post-morten of sheep over 2 years.

Francis (1959) reports that man may be infected with bovine type bacillus by direct contact or by meat products from variety of species. The flesh of the animal in an advanced stage of phthisis, must not be consumed due to the risk of its unhealthiness.

Generally Mycobacterium tuberculosis do not multiply outside the body, it multiplies only after infection. In goats the incidence is low due to natural resistance and it is felt that they are immune. (Annon, 1960).

Yadav (1971) reported an incidence of 0.65 % in goats in Mathura district in U.P.

Leptospirosis

Leptospirosis was considered a separate disease by Weil (1886) but its causal organism was attributed by Inada et al. (1916) to be Bicterohaemorrhagica. It was suggested that infection takes place through skin abrasion by contaminated water with rats urine. As the acid juice of stomach destroys the leptospiral organism, gastro-intestinal route was not considered common, but undoubtedly some outbreaks of human leptospirosis have been due to drinking or inadvently swallowing water contaminated by rats. Thus there is no theoritical reason why leptospirosis in man should not arise from the ingestion of contaminated or infected meat.

The leptospirosis as important zoonoses in India, was first recorded in human beings in Andaman Island (Taylor et al., 1931). A number of workers have reported serological evidence or infection among animals and human beings and also isolation of leptospiral strains from human patients.

Ayyar (1932), Das Gupta et al. (1937), Das Gupta (1939), Lahiri (1941), Ball et al. (1958), Sessi (1958), Adinarayan et al. (1960), Farina et al. (1960), Pande et al.

(1960, 1961), Seibold et al. (1961), Pargaonker et al. (1963), Pargaonker (1964), Joseph et al. (1966), Sawhney (1968), Yadav (1971).

Leptospiral infection in sheep and goats is characterized by white spotted kidney with chronic interstitial nephritis. (Sutherland et al. (1949), Beamer et al. (1953), Hoeden (1953), Hakioglu (1956), Alston et al. (1958), Burdin et al. (1958), Langhan et al. (1958), Mourse et al. (1958), Ferguson (1959), Pierothi (1959), Sleight et al.(1960), Babudieri et al.(1961), Smith et al. (1961), Tammemgi et al.(1961), Pargaonkar et al.(1963), Pargaonker (1964), Iyer et al.(1965), Kharole et al.(1968), Tomar (1968), Sharma et al.(1970), Khanna et al.(1971). The spirochaetes were demonstrated by special staining technique.

Lubanetsky (1949) suggested that carcass with liver degeneration without jaundice and emaciation having negative bacteriological examination after cooking, is fit for human consumption. Leptospira in infected meat dies in 30 minutes when heated to 50-55^{o}C, such meat when cooked from 2-8 hours in small pieces become harmless.

Hoeden (loc.cit.) reported an outbreak of leptospiral jaundice among goats in Israel. He has described the histopathological changes in the kidney of infected animals and felt that the disease might remain inapparent in goats.

Kotova (1955) while working on survival of leptospira in meat found that meat from artificially infected carcass was infective for 48 hours after death; 30 % infective after storage at 6°C. Infected meat dried over 8 days to 75 % of its original weight remained infective, drying over 13 days to half its original weight remained 15 % infective. It was harmless after storage for 10 days at -10°C to -20°C.

Burdin et al. (1958) reported an outbreak of leptospirosis in Kenya food animals and declared that there was high incidence of mild cases with renal lesions as sole manifestation of the disease, their possible importance as carrier is stressed.

Langham et al. (loc.cit.) developed experimental infection in 10 healthy lambs (4-5 months) and declared the gross lesion in kidney as characteristic of this infection. He demonstrated leptospira in kidney section by Warthin Starry method of staining.

Moure et al. (1953) felt that since goats may be infected with L. pomona infection through contact with experimentally infected calves, the goats should be considered as potential reservoir of leptospirosis for other host species. He experimentally infected the goats and

gave an account of symptoms and lesions of infection. His experimental goat voided urine which contained organism for 31 days. Goats even positive for leptospirosis were otherwise apparently healthy (also observed by Pargaonker et al., 1963 and Pargaonker, 1964).

MISCELLANEOUS:

Walz (1958) stated that aerobic spore forming organisms Bacillus subtilis was capable of liberating myoglobin from meat and of forming porphyrins in meat, thus reducing the wholesomeness of meat.

Chemical Food Poisoning

Certain toxic chemicals may be added deliberately to meat as preservatives. Certain metallic ions as lead, zinc, cadmium, antimony which are well known to exert injurious effects upon human body when ingested, are added to meat through utensils in the course of meat cooking or through food storage vessels, cans or foil wrapings and render it toxic.

Mac-donald (1945) referred to zinc poisoning caused by cooking or soaking acid foods in galvanized containers.

Carter et al.(1948) reported that D.D.T. in meat of animals fed on hay containing D.D.T. was not materially decomposed or lost during the process of roasting,

boiling, pressure cooking, braising and frying.

Pigoury et al.(1954) referred the harm from consumption of radio active mutton which when fed to rats developed marked increase in the reticulocytes and granulocytes and a loss of 10-17 % body weight. The radio active sheep developed bacteraemia of gram positive cocci and coliform organisms. The carcass became safe after 3 months cold storage.

Schellner et al.(1955) observed that the carcass of animal except viscera and udder, died of accidental arsenic poisoning, was fit for human consumption.

Durbin (1957) pointed out that antibodies residues in meat have not been proved to be harmless.

Ginsberg et al. (1957) suggested that oxytetracycline may be used for meat preservation and that it keeps the meat fit upto 72 hours. Destruction of oxytetracycline by cooking was also confirmed.

MATERIAL AND METHODS

MATERIAL AND METHODS

Material for undertaking the present study was collected from the small animal abattoirs, located in Mathura, Agra and Bareilly districts.

The postmortem examination was done in accordance with the instructions laid down by Mohlar et al (1939), Miller (1951), Thornton (1957), Albertsen et al (1957) and Drabble (1964).

5268 sheep and 5704 goats were examined in the above districts. The total number of sheep and goats districtwise being:-

District	Number examined		
	Sheep	Goats	Total
Mathura	741	389	1130
Agra	4261	4629	8890
Bareilly	266	686	952
Total:-	5268	5704	10972

The materials for microscopical examination, from different animal carcasses, were collected over ice in thermos flask just after slaughter, in polythene bags tagged separately; whereas the gross lesions were collected in clean tin containers containing normal saline solution.

Spleen (intact); piece of liver (500 gm approx.) taken from hiler region, together with portal lymph nodes and empty gall bladder; two lymph nodes (intact) - pre-scapular, prefemoral, popliteal and ischeatic; piece of muscle, covered by intact fascia (at least 250 gm.) from extensor muscles of the forearm, were collected with clean knife just after the slaughter and kept over ice, for laboratory study.

Collections from separate carcasses were made in separate polythene bags, properly tagged and numbered before preserving over ice.

After its laboratory processing or experimental trials it was preserved in formosaline solution for further study.

Parasitological examination

The parasitic conditions like fascioliasis, paramphistomiasis, hydatidosis, sarcosporidiasis and cysti-cercosis were identified by their gross and microscopic examinations. In some cases experimental trials were also undertaken for confirmation.

In the laboratory some of the cysts e.g., hydatid, were examined for their fertility and their percentage calculated.

Guinea pigs and pups were infected with scolices, while few scolices were studied microscopically after fixing and staining with borax carmine.

Similar studies were made in Coenurus gaigeri cyst infection which were found in almost all the locations of the body.

Scolices of Cysticercus bovis cysts and Cysticercus taenicolis cysts were pressed between slides to expose the hooks, fixed and stained as above.

Gross lesions of abscesses in different tissues were also studied histopathologically.

Impression smears were prepared either in the abattoir or in the laboratory from the abscesses, fixed over flame and preserved.

Cultures over blood agar/ nutrient agar were made out of the suspected abscesses in different locations in the body. Later on smears were prepared from them, fixed over flame and preserved.

The slides were stained by usual Gram's and Ziel-Neelsen's method of staining (Cruickshank, 1965); for final identification.

Examination of carcass for its bacteriological evaluation was done in accordance with the Danish rules and instructions for laboratory method of examinations, and the application in the hygienic judgement of carcass, 1954; 1968, (Albertsen loc.cit; Skovgaard, 1969) with slight modification wherever needed (Edward & Ewing, 1962; Cruickshank, 1965).

The purpose of this examination was to provide information on the bacteriological status of meat (muscle), lymph nodes and organs.

This was done by cultivating the material taken aseptically from the interior of the samples in different media, the following media were used for this purpose:

Nutrient or Broth peptone agar (pH 7.6) (Cruick-shank, 1965), Blood agar (5 % defibrinated blood), Bromo-thyml blue, lactose-sacchrose agar (Albertsen, 1957), Sulphite iron-deep agar tubes (Skovgaard, 1969), Brilliant green, lactose-sacchrose, phenol red agar (Albertsen, loc.cit., Edward & Ewing, 1962), Tetrathionate broth of Moellar (1923) modified by Kuffmann (1935) and Edward & Ewing,(loc.cit.), Triple Sugar Iron (T.S.I.) Agar modification of Kligler's Iron or Krumwiedes triple sugar agar as differential media (Albertsen, loc.cit.; Skovgaard, loc.cit.) and Urea medium (Christensen's Urea agar, 1944) cited by Edward & Ewing, loc.cit.

The medium were prepared as per the instructions laid down in Difco Manual, 1953; Edward and Ewing (1962); Cruickshank, 1965 and Skovgaard, 1969; and stored in the refrigerator till its use.

Inoculation of Media

Fatty tissues were removed from the surface of lymph nodes and the samples were fixed by means of metal pins to the wooden board.

The surface to be incised was first sterilized by means of hot spatula and then the incision was made with a sterilized knife.

Pieces of muscle and lymph nodes about the size of an almond, were removed aseptically from the interior layers of the tissues and transferred to Nutrient Agar (Petridish), Blood Agar (Petridish), Bromothymol blue lactose sacchrose agar (Petridish), Iron sulphite agar (tubes) - separate samples, and Tetrathionate broth (tubes) - mixed sample; Spleen to Nutrient agar (Petridish), Blood agar (Petridish), Bromothymol blue, lactose-sacchrose agar (Petridish), Iron sulphite agar (tubes) and tetrathionate broth (tubes) and liver, liver lymph nodes and Gall bladder (Scraping of mucosa from bladder), to tetrathionate broth (tubes)

The material being transferred to tetrathionate broth was crushed against the wall of the tube with the help of sterilized knife. The materials from muscle, spleen and lymph nodes after transfer to the empty petridishes were smeared against the bottom of the petridish in order to disperse part of the tissue material in the medium, while bulk of the tissue block was left to be embedded in the medium. Melted Nutrient Agar, blood agar and bromothymol blue lactose-sacchrose agar was then poured in the plates. The Iron sulphite agar tubes were melted, inoculated when cooled down to about 45°C and then the tubes were placed in cold water for agar to solidify.

All cultures except T.T.B. were placed in the incubator at 37-38°C and first reading was made after 16-18 hrs. Tetrathionate broth was incubated at 43°C for 18-24 hrs. as recommended by Harvey and Thomson (1953), Georgale and Boothroyd (1964), Elliott et al. (1965), Georgale et al. (1965), Petzold and Scheibner (1965), Harvey and Price (1967) and Hermans (1967).

A loop full of culture from broth was taken and aseptically streaked on the brilliant green lactose sacchrose, phenol red agar plates for isolation of Salmonella.

When the reading of agar plates and iron sulphite agar tubes were negative, a second reading was made after

further incubation for additional 24 hrs. (An incubation period of 40-48 hrs. is essential for the cultural demonstration of species such as Erysepalothrix & Corynebactpyogenous). Since these organisms are very often found to have multiplied only within the embedded tissue block itself, without giving rise to any visible colonies in the surrounding media, all the plate cultures found negative after four hours of incubation were examined microscopically by preparing gram stained smears from the tissue blocks for the presence of Erysepalothrix and Corynebacterium pyogenous.

The presence of green discolouration around the colony in the Nutrient agar media showed presence of Erysepalothrix.

Identification of positive culture was based on colony morphology, haemolysis in blood agar plates, fermentation reaction in the bromothymol blue agar plates and microscopic examination of stained slides with Gram's method.

Clostridium in the Iron Sulphite agar form black colonies, because of formation of Iron Sulphite. Black colour colonies are also shown by Salmonella and Arizona. Lack of growth in the Aerotric culture, indicated the presence of Clostridia.

Colonies suspected of being Salmonella were transferred from bromothymol blue, lactose-succhrose agar and brilliant green lactose-sacchrose agar to triple sugar iron agar by stabbing the butt and streaking the slant. The T.S.I. tubes were incubated at 37°C for 24 hrs. (Edward and Ewing, loc.cit.)

The culture displaying typical reaction of Salmonella on T.S.I. agar i.e., red slant showing alkaline reaction and yellow butt (acid reaction) with or without gas production, were retained while those showing acid reaction throughout the media were discarded. Black colouration of media was suggestive of H_2S production by the organism.

Positive cultures were further grown on solid urea medium and incubated at 37°C for their urease activity (Staurt et al.,1945). The reactions were observed after 1 hr., 2 hr., 4 hr. and so on. Those with alkaline reaction (red colour) were discarded whereas those exhibiting no change in colour were observed at least for 4 days for delayed reaction, if any; after which such cultures were declared urease negative and results interpreted (Difco Manual, 1953; Smith and Buxton (1957); Sharma and Singh (1961); Edward and Ewing (1962); Cruickshank (1965).

The organisms in bacteriological meat examination were classified as pathogenic or mixed flora of non-pathogenic bacteria resembling the natural intestinal flora.

Results were classified as sample sterile; specific infection (species, localization), low grade non-specific infection (when growth from one sample only; liver not counted), high grade non-specific infection (growth from two or more samples; liver not counted).

Simple, sterile and low grade non-specific type of meat were important from meat inspection point of view.

The histopathology was studied to establish that white spotted kidney in sheep and goat due to leptospiral infection as goats are considered as potential reservoirs of the leptospirosis for other host species (Mouse et al., 1958).

For this, 75 kidneys in all were selected, showing discrete greyish white foci with renal haemorrhage, without clinical manifestation of the disease in the animal slaughtered viz., Jaundice. (Alston and Broom, 1958).

The tissues were embedded in paraffin and 5 u thick sections were cut and fixed, stained with Haematoxylin and Eosin (Carlton, 1957; Luna, 1968).

One section from each series was also stained by silver impregnation method using Bridges and Luna's method of staining improvised by Turner and Reid (1965) with little modification (Warthin-Starry method cited by Carlton, 1957). This was done as follows:-

Sections are passed thD´xylol, descending grades of alchohol and triple distilled water.

Slides are the put in in 1 % silver nitrate solution at 43°C for 30 minutes.

Developer is prepared freshly by warming the ingredients at 55°C and adding them in following order.

2 % fresh solution of silver nitrate ...	1.50 ml.
5 % Gelatin solution	3.75 ml.
0.15 % fresh hydroquinone solution ...	2.00 ml.

Slides are removed from 1 % silver nitrate solution with paraffin coated forceps and put in the developer jar kept at 55°C for 3-12 minutes, till the sections were yellow.

Slides are rinsed with hot tap water (56°C) followed by triple distilled water.

Passing the slides through assending grades of alchohol for dehydration, sections are cleared in xylol and

mounted in DPX mordant.

Acidulated triple distilled water is used for preparing all the solutions (pH adjusted at 3.8 - 4.4 by 1 % fresh citric acid).

Leptospirae take black stain against pale, yellowish brown stained tissue in the back ground.

Experimental trials were undertaken in guinea-pig and pups for establishing infection of Echinococcus by feeding scolices of fertile hydatid cyst.

Similar infections were also given in pups by feeding fresh Coenurus gaigeri cyst collected from goats from which Multiceps Gaigeri (Hall, 1916 cited by Southwell, 1930) was collected on autopsy and preserved in DPX after staining by borax carmine.

Experimental trials were made to establish the effect of deep freezing on hydatid cyst.

For this fertile hydatid cysts were collected and six pups aged 15-20 days were arranged.

Two pups were fed with fresh hydatid cyst while the other cysts were kept in the freezing chamber ($-4^{o}C$) from which they were fed to tagged and numbered pups after

24 hours, 48 hours, 72 hours and 96 hours.

The pups were later autopsied for identification of the establishment of infection, if any.

OBSERVATIONS AND RESULTS

OBSERVATIONS AND RESULTS

I. PARASITIC CONDITIONS

Cysticercus tenuicollis (Larval Stage of *T. hydatigena*).

This was encountered often attached to the peritoneum, mesentery and liver. It was mostly seen in the liver tissue, where a groove was found, after its removal. The animals harbour one or more cysts, but in one case, sixteen cysts were found attached and embedded in liver which was reduced to a considerable extent. Out of 5268 sheep and 5704 goats examined, 687 sheep and 568 goats were found to be infected, thus the percentage being 13.0 % and 9.9 % respectively.

The rostellar hooks, 28-36 in number, were arranged in two rows, with large hooks measuring 169 u to 184 u and smaller 107 u to 138 u in size (In accordance with Soulsby, 1968).

Coenurus gaigeri (Larval Stage of *T. gaigeri*).

Out of 5704 goats, it was encountered in 31 goats i.e., 0.54 %. They were embedded in intramuscular connective tissue (Fig.1), but in few cases, was seen attached to liver in the suprarenal fossa in between the kidney and liver (Fig.2), brain and submandibular space

heart (fig 4),
(Fig.3), In one particular case 71 cysts were recovered from almost all the organs, subcutaneous and intramuscular tissues, the largest being 8 cm. and smallest 1 cm. in diameter. (Fig.5).

To ascertain its correct identity the scolices from one of the cysts were fed to two pups. One of the pups died after 11 days of infection. On post mortem examination, the immature worms measuring 6-8 mm. in length were recovered. They had 32 hooks arranged in two rows. The larger hook measured 154 u while the smaller one as 107 u in size. Another pup died after 13 days of infection, the worm measured 102 mm. in length, the 32 hooks were arranged in two rows, larger hooks measured 184-215 u and smaller 123-138 u in size (Fig.6).

Thus the comparative increase in size of the worm alongwith age, the number of hooks and its corresponding increase in size suggest T. gaigeri infection (Southwell, 1930 and Soulsby loc.cit.)

Hydatid cyst

Out of total number of 5268 sheep and 5704 goats, 472 sheep (8.1 %) and 481 goats (8.2 %) were found infected. Cysts were more frequently encountered in the lungs than liver and spleen. The cysts in liver were 1-10 cm. in

size and were bigger than those in the lungs (1.6 cm.). No hydatid cyst was recovered in any other organ of these species. The cysts in the lung were unlobular but in the liver they were multilobular (Fig.6). About 78-80 % of the lung cysts and 95 % liver cysts were found to be fertile.

The fertile cysts were fed to a clean pup and guinea pig. It failed to develop in the guinea pig. But in pup 480 immature worms were recovered after 33 days after the infection (Fig.5). Some of the cysts were kept in the deep freeze for 24, 48, 72 and 96 hours, before infecting the final host i.e., pup. The development occurred in pups fed with cysts kept in deep freeze for 24 and 48 hours, but failed to develop in pups which were fed with cysts kept for 72 and 96 hours in deep freeze. This indicates that the cysts are viable in deep freeze only upto 48 hours.

Liver flukes (Fascioliasis).

A total of 5268 sheep and 5704 goats were examined during the present survey in Mathura, Agra and Bareilly districts. The district-wise results in sheep and goats are tabulated below, (TABLE-II).

TABLE II - District wise incidence of fascioliasis in sheep and goat.

Place	Sheep			Goat		
	Total number of animals		Percentage.	Total number of animals		Percentage.
	Examined	Affected		Examined	Affected	
Mathura	741	102	13.7 %	389	48	12.3 %
Agra	4268	616	14.4 %	4629	483	10.4 %
Bareilly	266	28	10.5 %	686	53	7.8 %
Total:	5268	746	14.0 %	5704	584	10.2 %

The incidence was more during July to October than November to January. The infected liver was enlarged, pale and friable. Worms could be seen moving from bile ducts giving an unsighty appearance. The liver parenchyma was destroyed with evidence of haemorrhage.

The other conditions encountered are tabulated below, (TABLE-III).

TABLE III - Showing Miscellaneous Pathological conditions in sheep and goat.

Disease conditions	SHEEP - Total examined 5268		GOAT - Total examined 5704	
	Total found positive	Percentage	Total found positive	Percentage
Lymphadenitis.	227	5.0	-	-
Multiple liver abscess.	222	4.2	118	2.0
Hepatitis and Cirrhosis of liver.	154	2.9	139	2.4

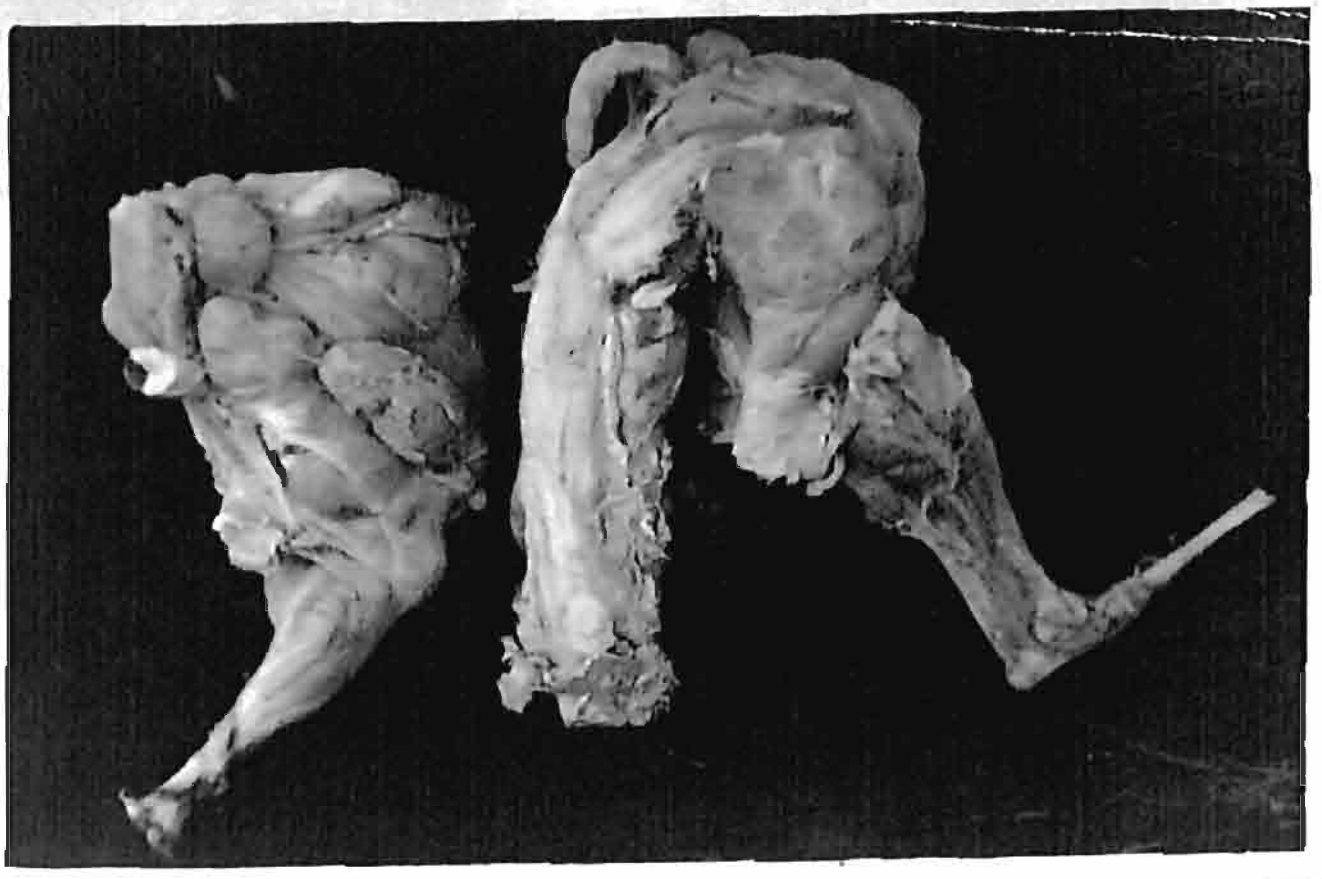

Fig.1. Photograph of different parts of body of a slaughtered goat showing generalized distribution of Coenurus gaigeri cysts in the body.

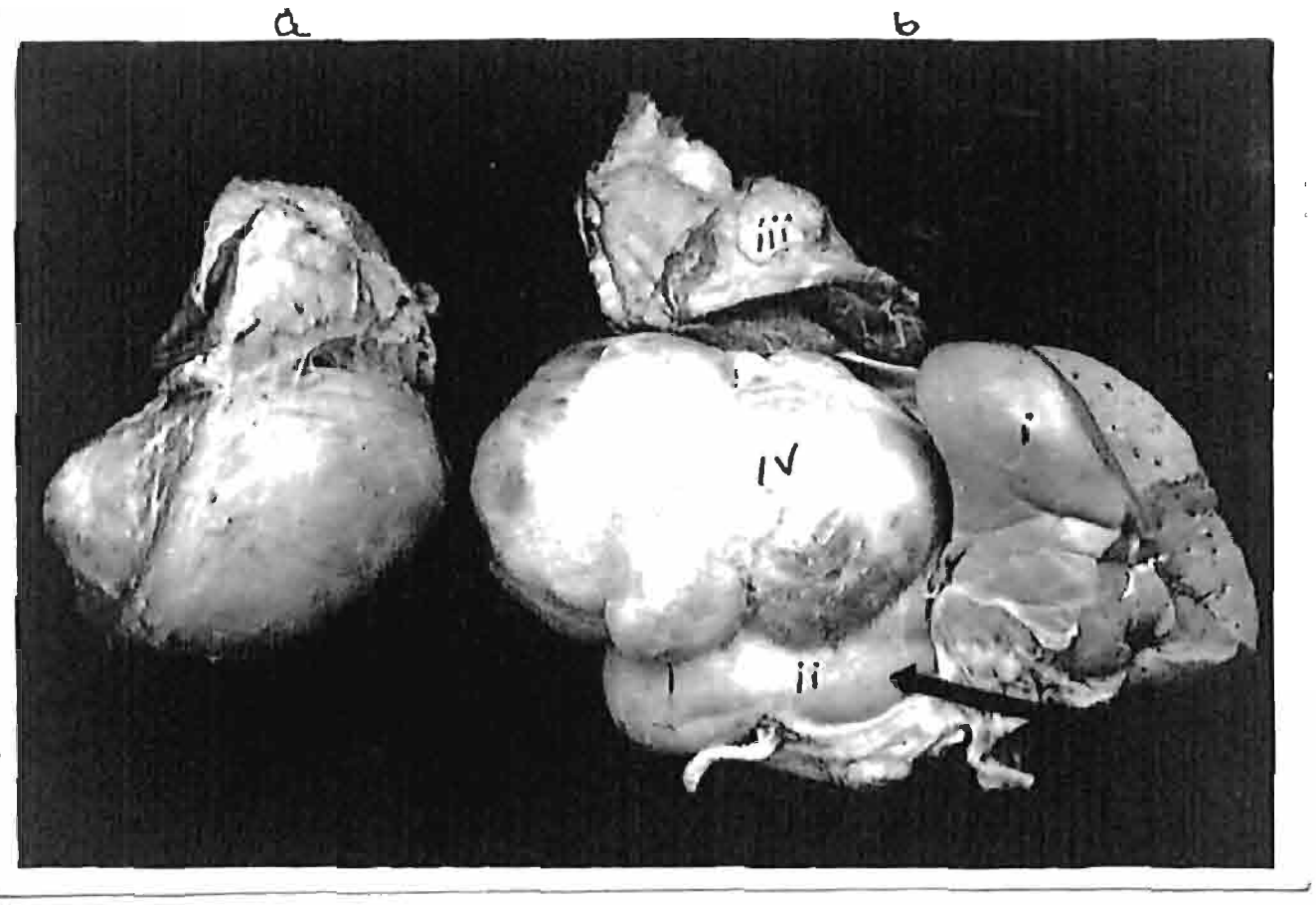

Fig.2. Another photograph showing C.gaigeri cyst embedded in (a)intramuscular connective tissue,(b) suprarenal fossa showing (i) liver,(ii) kidney,(iii) muscular adhesions and (iv) cyst.

Fig.3. Photograph of horizental section of head of the goat showing Coenurus gaigeri cyst in the (i)brain,and (ii) sub mandibular space.

Fig. 4. Photograph of lung and heart of the goat showing C.gaigeri cyst over the auricle of heart.

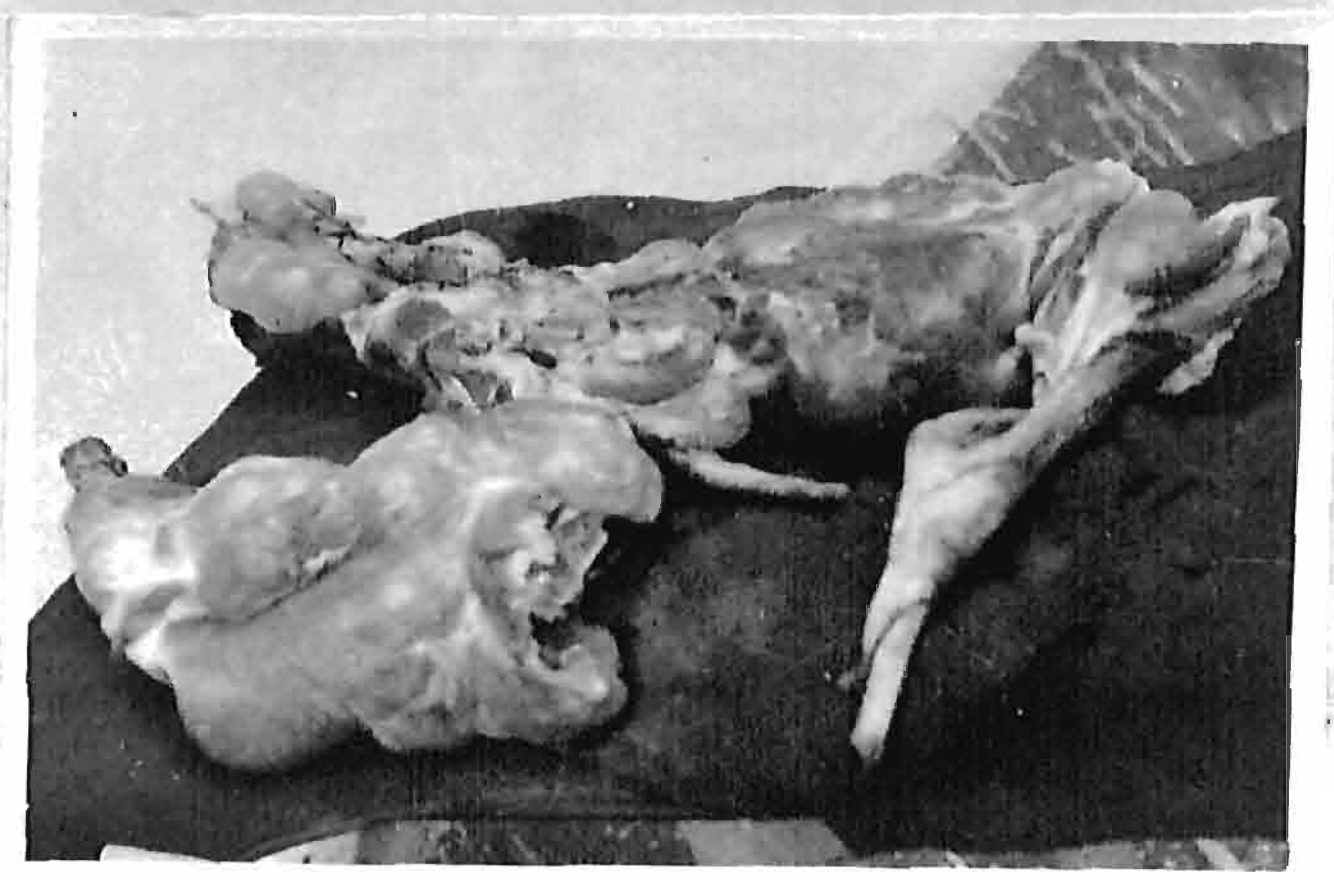

Fig.5. Photograph of the body of goat showing multiple distribution of Coenurus gaigeri in different locations.

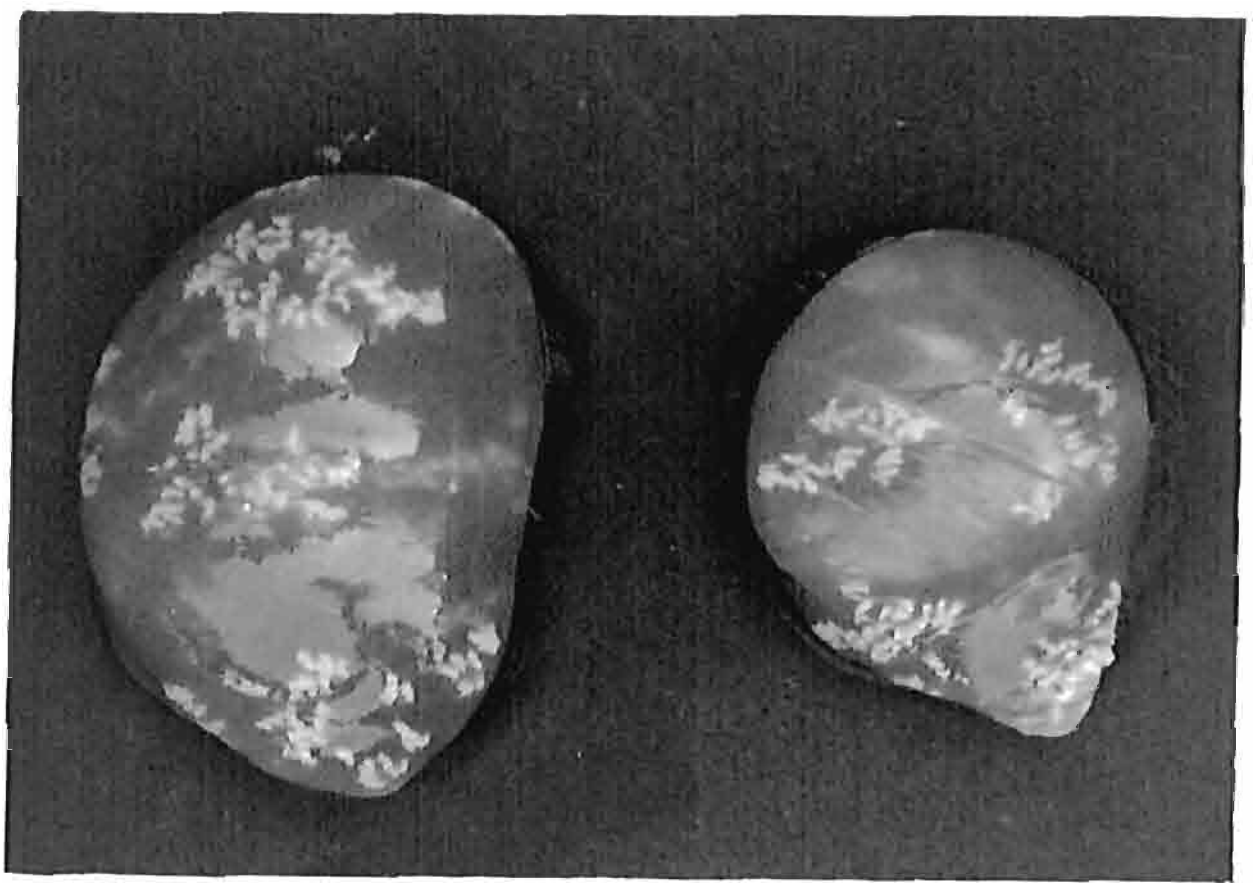

Fig.6. Photograph of the exposed cysts of C.gaigeri.

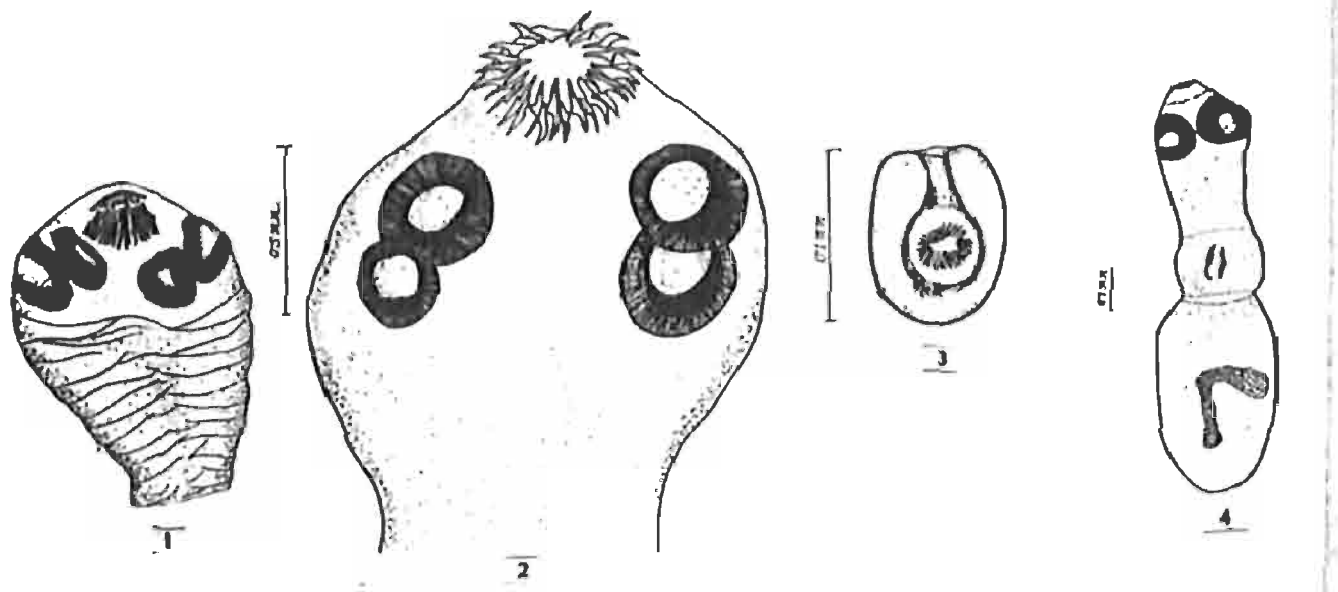

Fig.7. Camera lucida drawings of (1) scolex from Coenurus gaigeri cyst, (2) Taenia gaigeri, collected from experimentally infected pup after 13 days infection. (3) scolex from fertile hydatid cyst, & (4) E. granulosus, collected from experimentally infected pup after 33 days of infection.

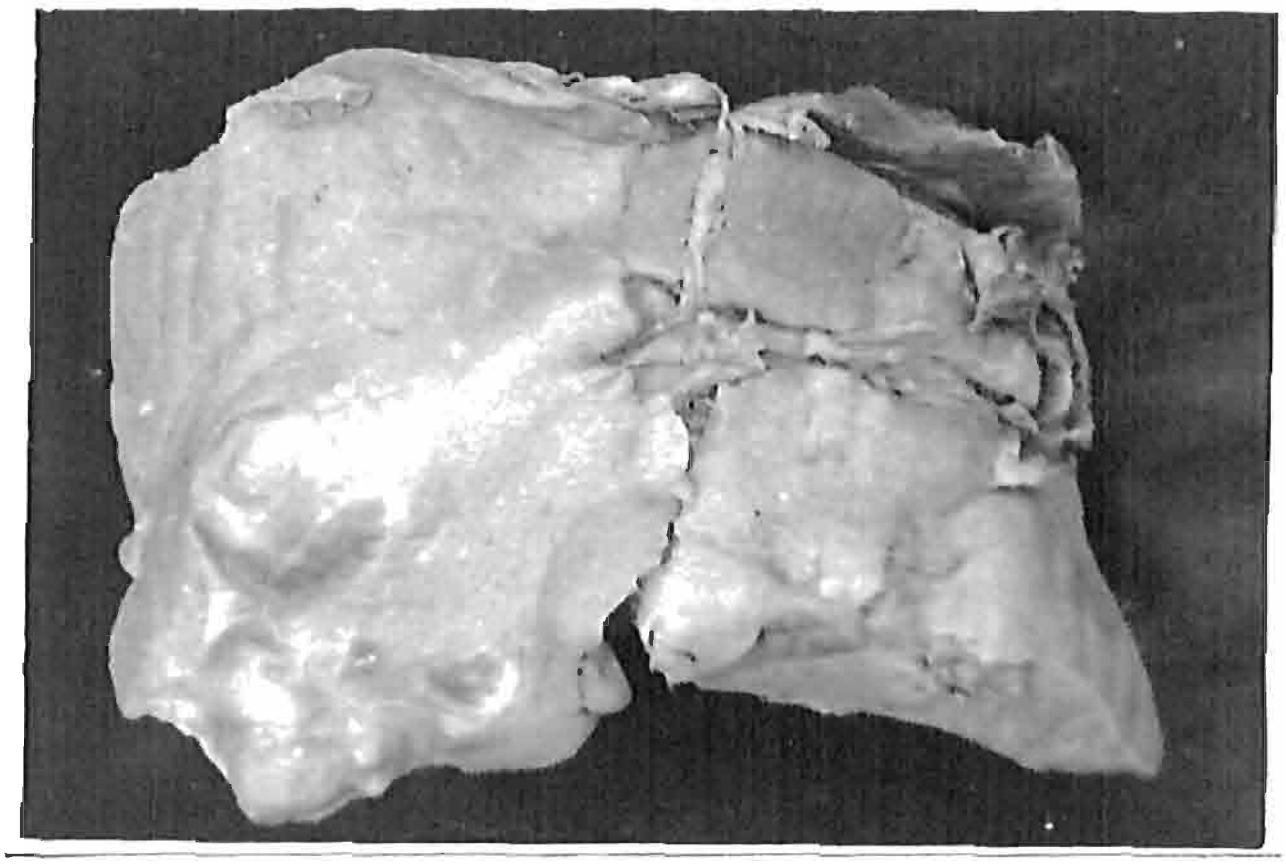

Fig.8. Photograph of liver of sheep showing multilobular hydatid cyst.

II. Bacteriological Examination of lesions.

A. Tuberculosis

During the present investigation out of 5268 sheep and 5704 goats, 32 sheep (0.6 %) and 188 goats (3.2 %) were observed with lesions of tuberculosis. Acid fast organisms in the impression smears stained by Ziel-Neelson's method of staining was observed in 72 % of the animals. Lesions in sheep were mostly encountered in the lungs and lymphatic glands while in goats they also involved the kidneys. The well capsulated lesions were suggestive of chronic conditions. (Fig.9). Two cases of generalized form in goats were observed which were confirmed by impression smears while in sheep only one case of generalized tubercles in the body was observed which was found to be positive for corynebacterium confirmed by Uttap (1972).

B. Abscesses

Abscesses caused by micro-organisms are most commonly met in all food animals under the present study, more number of abscesses were encountered in sheep than in goats. Abscesses in lymph nodes were more commonly seen followed by those in liver, Fig 10 lungs, muscles, kidneys and other tissues. In total 254 abscesses from sheep and 268 abscesses from goats from different locations of the body

were examined, the results of which were as under (TABLE-IV A and B).

TABLE - IV

Location	Total Number Examined	Organisms observed by gram's staining				
		Staphylococci	Streptococci	Gram-positive bacilli	Gram negative bacilli	Coccobacillary
		A - SHEEP				
Liver.	35	12	5	8	10	-
Muscle.	29	5	8	3	13	-
Lymph glands.	110	30	8	53	12	27
Lungs.	27	18	3	4	2	-
Miscellaneous.	53	12	2	12	8	12
Total:	254	87	26	80	45	39
		B - GOAT				
Liver.	50	19	18	3	10	-
Muscle.	38	11	11	5	7	4
Lymph glands.	89	45	15	18	5	6
Lungs.	29	11	9	4	5	-
Miscellaneous.	62	26	14	8	9	5
Total:	268	112	67	38	36	15

III. Cultural Examination of microorganisms.

A total of 16 lymph nodes, 8 muscle pieces, 8 spleen and 8 livers were examined from sheep and 56 lymph nodes, 28 muscle pieces, 28 spleen and 28 livers were examined from goats and different media, the results of which are shown in TABLE-V A-for sheep and B-for goats.

TABLE - V

Bacteriological Examination of Meat samples.

Organs	Total Number Examined	HAEMOLYTIC				NON-HAEMOLYTIC				Bacillus Subtilis	Clostridium species	Salmonella species
		Staphylococci	Streptococci	Gram positive bacilli	Gram negative bacilli	Staphylococci	Streptococci	Gram positive bacilli	Gram negative bacilli			
A - SHEEP												
Lymph nodes.	16	5	2	1	2	2	1	2	1	-	5	1
Muscles.	8	4	1	1	-	3	1	4	3	-	5	
Spleen.	8	1	1	-	-	6	-	1	2	-	4	-
Liver with gall bladder and associated lymph nodes.	8	-	-	-	-	-	-	-	-	-	-	-
B - GOAT												
Lymph nodes.	56	13	5	13	9	23	11	7	5	3	15	17
Muscles.	28	9	2	9	3	13	3	5	3	2	13	
Spleen.	28	4	-	7	1	16	4	3	4	1	10	11
Liver with gall bladder and associated lymph nodes.	28	-	-	-	-	-	-	-	-	-	-	11

Fig.9. Photograph of pleura of goat, showing tuberculous lesions.

Fig.10. Photograph of a liver of sheep, showing multiple abscesses.

IV. HISTOPATHOLOGICAL EXAMINATION

Out of 5268 sheep and 5704 goats examined, 121 kidneys (2.2 %) of sheep and 329 (5.7 %) of goats were found showing discrete white spots with or without renal haemorrhage in one or both the kidneys (Fig.3). 75 kidneys were selected for histopathological examination. One section was stained with Haematoxylin and Eosin while the other by silver impregnation technique.

All the 75 sections histologically revealed changes associated with acute focal or chronic intestinal nephritis characterized by mononuclear cell infiltration especially on periglomerular and perivascular region (Fig.12). The tubular epithelium showed varying degree of degenerative changes from cloudy swelling to necrosis and were at times distended by granular debris, protein casts and occasionally casts of blood pigments (Fig.15). In few cases interstitial fibrosis were also observed (Fig.14). In five sections stained by silver impregnative method, black clumps or spirae morphologically identical to leptospira were also observed (Fig.15&16)

Fig.11. Photograph of kidneys of goat, showing white spots over the cortical surface, observe haemorrhagic scar in one.

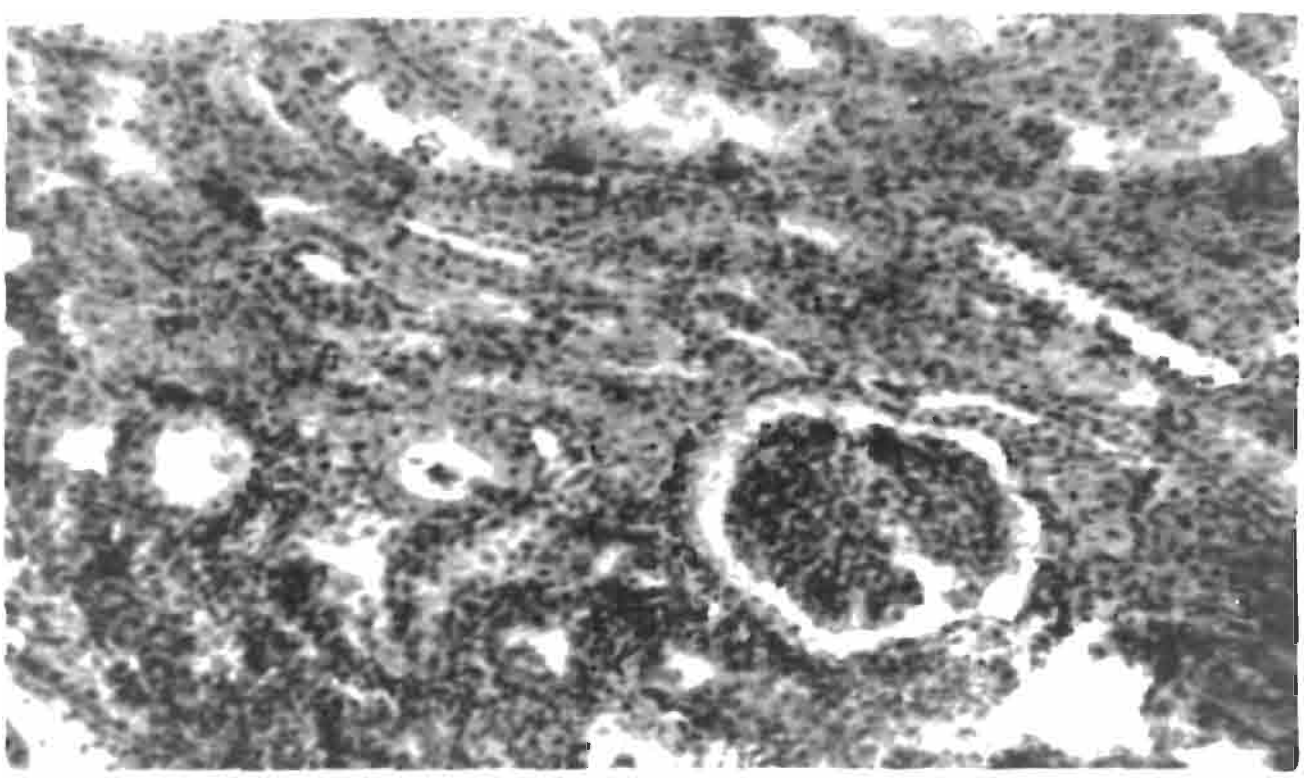

Fig.12. Microphotograph of a section of kidney, observe periglomerular and perivascular infiltration of mononuclear cells with granular casts in the tubular lumen. (stained by H & E , X 150.)

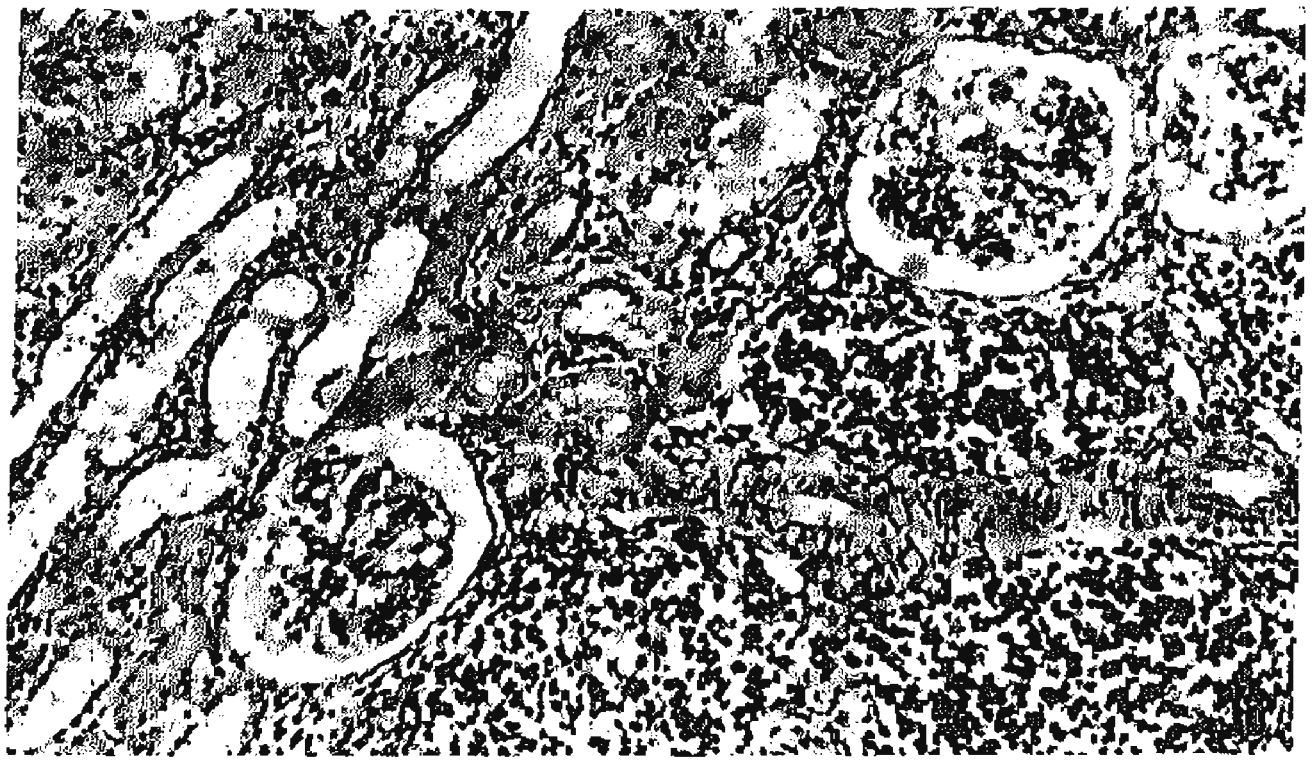

Fig.13. Microphotograph of a section of kidney, observe degerative changes in the tubular epithelium, tubules distended with granular debris & protien casts. (stained by H & E X 150.)

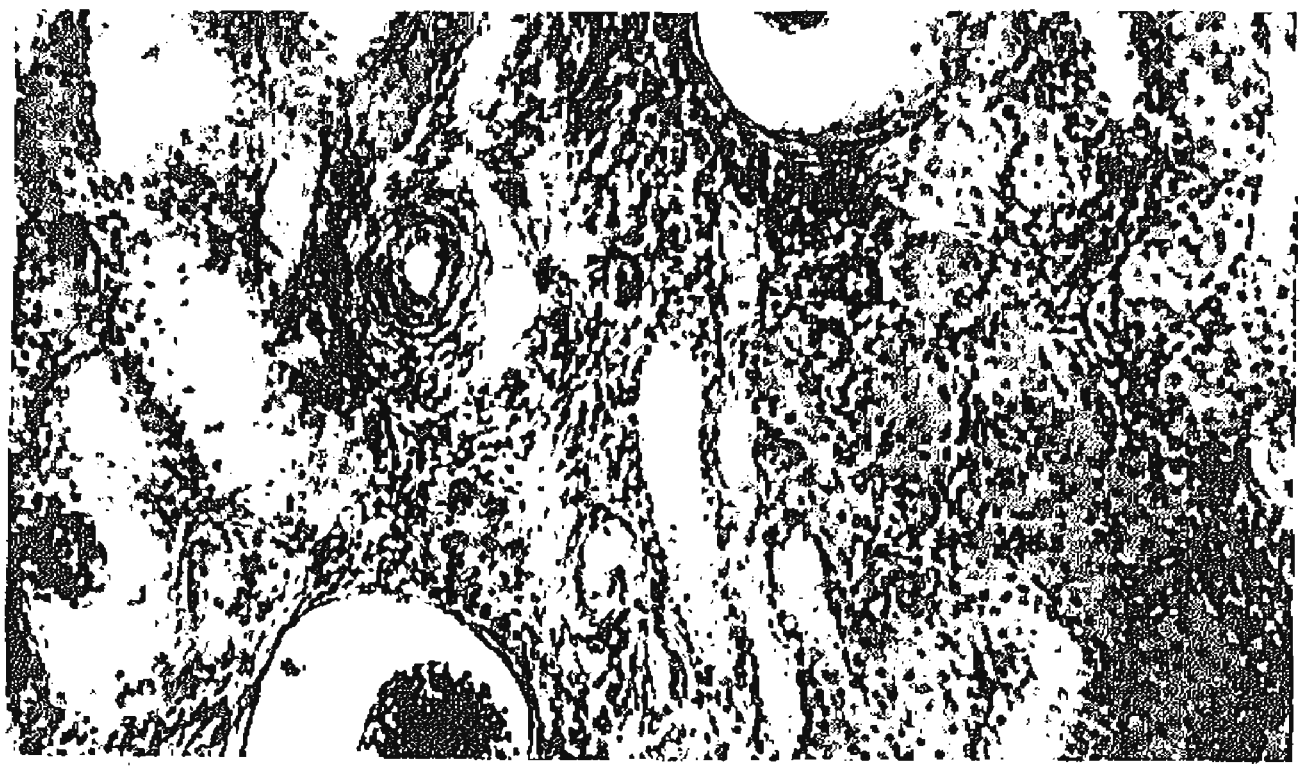

Fig.14. Microphotograph of a section of kidney, observe the interstitial fibrosis and infiltration of mononuclear cells with atrophy of the tubules. (H & E X 150.)

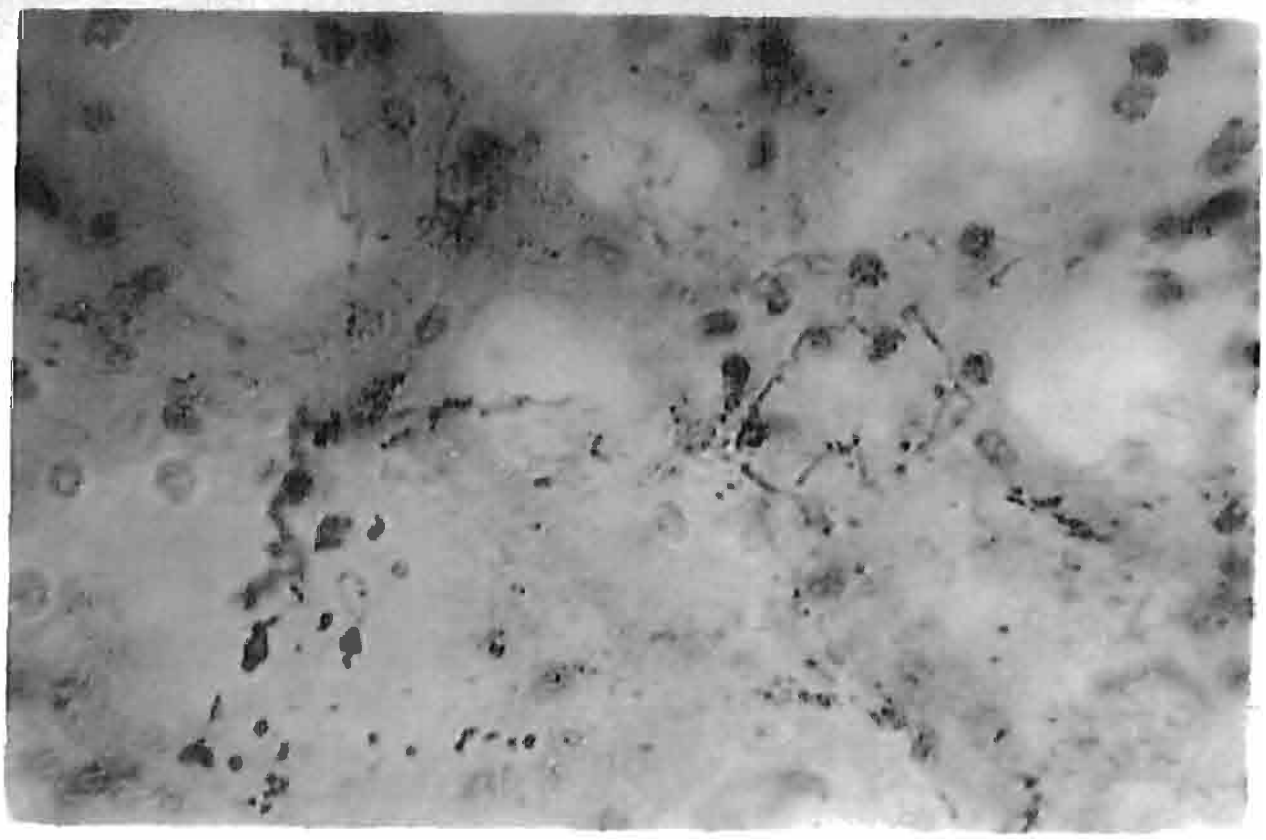

Fig.15. Microphotograph of a section of kidney, observe the spiral organisms in clumps. (silver impregnation X 330.)

Fig.16. Same as fig.15, enlarged. (X 1500.)

DISCUSSIONS

The object of the present study was to find out various disease conditions in sheep and goat, which are the chief meat animals in our country, from meat inspection point of view.

I. Parasitic Conditions:

A variety of parasitic conditions prevalent in these animals are of economic importance as they reduce the wholesomeness, palatability and keeping quality of meat, rendering it unfit and unhygienic for human consumption. The other conditions which render the meat unfit for consumption are grouped under zoonosis. Such meat which are not wholesome are condemned and thus it is of great economic importance.

Bacterial and viral diseases can be diagnosed and controlled in living animals but some of the parasitic conditions could only be diagnosed during post mortem. Such conditions include various larval stages of dog tapeworms.

Cysticercus tenuicollis breaks down the liver parenchyma during their migration, causing haemorrhage

and leaving behind a track of detritus thus permitting the entry of secondary invaders. Finding of cysticercus infection in 13 % sheep and 9.9 % goats, indicate indirectly a heavy infestation of T. hydatigena in local dogs.

Soulsby (1965) reports that this cyst is found in man but according to him its correctness is doubled.

Cases of hepatitis cysticercosa (Soulsby, 1968; Deorani, 1967) and Pneumonitis cysticercosa (Wadhar and Narangpur, 1969) in goats have been recorded.

An association of Cysticercus tenuicollis with black disease caused by Clostridium oedematiens (Novyi) has been reported by Turner (1930).

The disease is much of economic importance as for this infection alone heavy percentage of livers are condemned (Collins, 1939; Murydin, 1960 and Wadav, 1971).

Coenurus cerebri

This parasite has not much been reported till date. Its incidence indirectly indicates infection of Multiceps cerebri in local dogs. The parasitic cyst, which was mostly encountered intramuscular, causes degeneration of the muscle fibres, thus reducing the food value of meat.

Rare finding of cysts in one goat in almost all the organs and tissues have been recorded, probably for the first time.

There are reports of multiceps multiceps cyst in sheep and goat but in man this has not been recorded so far. Hence this finding is of much importance from economic point of view.

Hydatid cyst

Importance of this disease is in two ways, human health point of view and economic aspect. This is not directly transmitted to man by ingestion of infected meat, the disease of "boiled hands" as is called by French, is acquired by man through ingestion of Echinococcus granulosus eggs derived from dogs. Dogs become infected by consumption of offals containing the cyst. A high percentage of this infestation in sheep (0.1 %) and goats (0.2 %) indicates a very heavy infection of Echinococcus granulosus in local dogs. This is probably because of the laxity usually encountered in disposal of infected viscera, particularly around abattoirs in our country.

Selvaraj (1967) reported it to be most conspicuous parasitic condition in the liver of sheep (39.79 %) and goat 16 %) in Madras.

Prakash, et al. (1967) reported an infection of 9.5 % in sheep and 9.9 % in goats of Delhi.

Uncommon with many other parasitic conditions, the disease is seldom diagnosed in man until surgical interference is made. Paul (1957), Paul and Fernandom (1957), Sayed, et al. (1962) have reported several cases of hydatid disease in liver, lung and kidney in human patients in India. Prakash et al. (loc.cit.) reported that 3 out of 10,000 admissions from all cases in two hospitals in Delhi were of hydatid infection and a good number of cases certainly die undiagnosed because the medical facilities are very meagre in vast rural area.

The disease can be controlled by treatment of dogs with Arecoline hydrobromide and proper disposal of offals and viscera affected with hydatid disease.

Infection in guinea pig did not develop which is in accordance with Smyth (1964)

Results of retention of infective power by the hydatid cyst after deep freezing (-4°C) for 48 hours, is an important aspect towards meat preservation by deep freezing which is further an aid towards the eradication of this infection.

Schmey and Hugge (1931) discussed the viability of cysticercosis cyst after freezing and found that 4 days freezing at -5°C to -10°C kills the cyst. In our observation also it is clear that the cysts are viable for 48 hours in deep freeze (-4°C). No such records are available in our country.

Liver fluke (Fascioliasis)

This is a disease of economics and public health importance. In the present study a heavy percentage of infection was observed in sheep (12.8 %) and goats (10.1 %) with variable incidence from place to place and from time to time. Great variation has also been observed in the incidence in sheep and goats. This degree of variation seems to be due to variation of grazing habits of these closely related animals (sheep being more closely grazer than goats).

Kendall (1955) reported from Pakistan that husbandry of sheep and goats had become impossible owing to pathogenic effect of the disease with a high rate of morbidity and mortality. He reported an incidence of fascioliasis in West Pakistan (New Pakistan) as 70-80 % and in East Pakistan (New Bangla Desh) as 60 %.

Zoonotic importance of fascioliasis in the world have been discussed by Faust and Russell (1957), Jones and Smith (1964) and Mitchell (1969).

From India, there seems to be no published records of this disease in human beings so far, but it does not rule out the possibility of Fasciola infection.

An association of fascioliasis with Black disease caused by Clostridium oedematiens (novyi) has been reported. This anaerobe proliferates in the anaerobic necrotic lesions produced by the immature trematodes (Moulday, 1968).

II. Bacterial conditions

Tuberculosis is not only important for its contagious nature and disease producing power in animals but also it has great public health significance. The bovine type bacillus is responsible for certain forms of human tuberculosis, the proportion of such cases varying fairly widely from country to country (Cottler and Weber, 1954) from the findings, it is clear that all animal sources of human infection are worthy of attention. The food stuffs are the first to be suspected for such dangers.

During the present survey, an incidence of tuberculosis in sheep (0.6 %) and in goats (3.2 %)

slaughtered for meat purposes, is quite alarming.

Tuberculosis in goats have been recorded by Iyer (1932), Nanda and Singh (1943), Sahai (1943), Radhey Mohan (1950) as 0.97 %, Malhotra (1969), Lall (1969) as 0.39 %, and Yadav (1971) as 0.65 %.

In sheep the first authentic report of tuberculosis was recorded by Nanda and Singh (1944) in Hissar. There are many records of tuberculin positive reactors from different parts of the country in different food animals (Singh, 1951; Lall, 1966 and Malhotra, 1969).

More incidence in these animals is attributed to the fact that now since these animals are kept in captivity under which condition all the species of animals are susceptible to this disease and the clean animals when exposed to infection pick up quickly.

Tuberculosis in animals is important in two ways. Firstly it is a problem of human infection through meat and secondarily socio-economic problem resulting from the wastage of animal protein due to condemnation of infected offals.

Simultaneous lesions in lungs and kidney have been observed in goats which are regarded as proof of haematogenous distribution of bacilli (Cohrs, 1941), which

are arrested in the circulation in muscles and muscular tissue and pass into the stream during extreme pain at the time of slaughter (Cohrs, 1943).

The statement that the goat is immune to tuberculosis (Thornton, 1957) is, however, incorrect, as quite a good numbers of goats were found positive during the present survey.

BACTERIAL EXAMINATION

Abscesses in the animal body indicate pyogenic condition of varying degree (localised or generalised), preceeding bacteraemia. The presence of abscess specially in liver, kidney and muscle is of great economic importance as such meat being unfit for human consumption, is discarded. More incidence was recorded in sheep (6.2 %) than goats (3.5 %) and the number of abscesses were recorded more in lymph glands followed by liver, lungs, muscles, kidneys and other tissues.

Selvaraj (1967) recorded 4.36 % abscesses in sheep and 4.0 % in goats liver in Madras abattoir.

Yadav recorded 4.1 % in sheep and 2.94 % in goats in Mathura district in U.P. and found more number of abscesses in lungs than livers.

finding a pathogenic organism in the abscess is still more important in meat hygiene, and in the present study gram positive staphylococci were recorded in 77 cases out of 254 examinations in sheep and in 112 cases out of 360 examinations in goat. Soiling of meat by the contents of abscess can by no means be avoided during dressing of carcass in the abattoir. Thus its importance increases.

Outbreaks of poisoning due to staphylococcal toxins have been recorded by several workers due to ingestion of raw, partially or improperly cooked and boiled meat (Scott and Stewart, 1943; Allison, Hobbs and Martin, 1949; Arcoli, 1959).

More work in this direction is needed.

III. Microbiology of Meat

Meat is most favourable media for bacterial growth. Its growth reduces the quality of meat which becomes unwholesome, unhygienic and the keeping quality is reduced. Infection generally takes place on the surface, but sometimes inner muscles may also be involved due to mechanical action.

The present study includes the isolation of microbes from the interior of the tissues of slaughtered

sheep (9) and goats (28). It has been found that comparatively more pathogenic species of organisms were encountered in lymph nodes than other organs. In sheep total number of haemolytic staphylococci were observed in 26 out of 112 samples of lymph glands, muscles and spleen, while 38 were positive for clostridial species.

Salmonella, another important pathogenic organism responsible for food poisoning was encountered in 26 out of 112 samples of muscle, lymph and spleen and in 11 out of 26 liver samples of sheep. In goat out of 32 samples of lymph, muscle and spleen, 10 were positive for haemolytic staphylococci, 14 for clostridial species and one for Salmonella sp., while out of 8 liver samples, none was positive for Salmonella sp. This again confirms the finding of more prevalence of infection in sheep than goats.

Harmful effects by eating meat containing Staphylococcus or Salmonella organisms have been described by Mc donald (1945); whence it is felt that since ten toxin causes harmful effects, its presence in meat is warranted (Kampa, 1945) and also that the presence of this organism is harmful when the meat is required to be preserved, since the organism produces enterotoxin in salted, boiled or smoked meat (Artioli, 1959).

Schoof and Levaman (1939) found anaerobes in descending order in liver, kidney, spleen and muscles and also declared sheep to be more frequently affected than other food animals. Similar findings have been recorded in this case.

Prokhorov (1941) isolated Salmonella in 3 %, E. coli in 24 % and Cocci in 20.2 % of 163 mutton samples.

The following organisms from meat and meat products were isolated by Ikura (1943).

Bacillus, Clostridia, Salmonella, Moorthella, Escherichia, Proteus, Streptococcus, Staphylococcus, Corynebacterium, Diplococcus and Aerobacter.

The present finding indicates the importance of bacteriological examination of meat, as in the absence of this examination, a good number of pathogenic micro-organisms, otherwise harmful, are missed (Ayron, 1955; Pantaleon et al., 1962).

The principal conditions due to bacteria and their toxins are tabulated (TABLE-VI).

TABLE - VI

CHARACTERISTICS OF PRINCIPAL MEAT BORNE INFECTIONS AND INTOXICATIONS WITH ACUTE ONSET

Causal Agent	Type of Meat Product commonly involved	Symptoms	Onset of symptoms after eating
Clost. Botulinum	Processed meat	Difficulty in swallowing, vision, speech and respiration followed by death from paralysis of muscles of respiration	2 Hrs.- 8 days (Av. 1-2 days)
Cl. Perfringen (Welchii)	Re-heated meat, meat pies, cold meats, strews and made up dishes.	Nauscea sometimes vomiting, colicky pains, diarrhoea, symptoms seldom persist longer than 8-12 hrs.	2 - 18 hrs. (Av. 11-15 hrs.)
Salmonella sp.	Meat and meat products processed	Abdominal pain, diarrhoea, chills, fever, frequent vomiting and prostration.	7 - 12 hrs. (Av. 8-10 hrs.)
Shigella	Cold and processed meat	Diarrhoea, bloody stools, fever in severe cases	12 hrs.- 7 days (Av. 2-3 days)
Staphylococcus sp. (Enterotoxins)	Processed meat	Salivation, nauscea, vomiting, crams, diarrhoea, prostration usually no fever. Recovered in about 24 hrs.	6 hrs. (Av. 2½ hrs.)
Trichinella Spiralis	Raw or inadequately cooked or otherwise processed pork and pork products.	Oedema of Eyelids and face, swelling and pain of muscles, Eosinophilia in fever cases, Hyperpyrexia and Diarrhoea.	2 - 28 days (Av. 9 days)

Leptospirosis

Leptospirosis was recognised as important zoonoses by Taylor (1931) in India who recorded the infection in human beings in Andaman Island. The explanation that leptospirosis remains inapparent in goats (Hesdon, 1953), and goats should be considered as potential reservoirs of leptospiral infection (Morse and Langham, 1958), is confirmed in the present study by finding morphologically identical organisms in sections of kidney from apparently healthy goats. A finding which confirms the observations made by Iyer and Nanda (1965) and Kharole and Rao (1969).

Organisms morphologically identical have been observed in 6 out of 75 sections, while inflammatory changes have been observed in all the 75 kidneys ranging from acute focal to fibrolytic type. Identical cases have been confirmed by Hesdon (1953), Morse and Langham (1958), Seibold, Kaech, Norbert and Nokolman (1961), Iyer and Nanda (1965) and Khanna and Iyer (1971).

In another lesions where leptospira could not be demonstrated in section, it has been attributed to the possibility of the antibodies brought by the lymphocytes which cause their disappearance from the lesion (Seibold, et al.) (loc.cit.)

Leptospiral infection appears to be of considerable significance in the health of man and its finding in meat animal is important from public health point of view.

———————:0:———————

SUMMARY

A total of 10972 animals (5268 sheep and 5704 goats) were examined after slaughter in the different slaughter houses of Mathura, Agra and Moradily districts. The survey was conducted to find out the various conditions of zoonotic importance and for the wholesome supply of meat. Some of the conditions - parasitic, bacterial and their toxins and other miscellaneous diseases were studied.

During the present survey 13 % of sheep and 9.9 % of goats were found to harbour Cysticercus tenuicollis infection in the peritoneum, mesentery and liver. The loss due to this parasite has been accounted for.

Coenurus cerebri infection was found in 0.54 % goats. This was encountered in liver and brain, in addition to intramuscular connective tissue. It was developed to adult stage in clean pup.

Hydatid cysts were found in 0.1 % sheep and 0.2 % of goats examined, well placed in the liver or lung tissues. 70-80 % of lung cysts and 95 % of liver cysts were found to be fertile. Echinococcus granulosus was recovered from pups after feeding fertile cysts, but the cyst failed to

develop in the guinea pig.

Viability of the cyst upto 48 hours in the refrigerator was confirmed which is an important factor in preservation of meat in cold storage.

The incidence of fasciolasis was encountered more commonly in sheep than goats of district Agra than in Mathura or Bareilly, and also comparatively more during the months of July to October.

In total 14 % sheep and 10.2 % goats were found affected with this infection resulting in good loss of liver tissue for mank purposes, as in most of the cases, liver tissue was discarded.

Lymphadenitis was encountered in 9 % sheep, multiple liver abscess in 6.2 % sheep and 2.0 % goat, cirrhosis of liver in 2.9 % sheep and 3.4 % goats.

Besides economic loss from these conditions, in case of generalised inflammatory pyaemic conditions involved through haematogenous route, these conditions attributes to the infections transferred through meat to the handlers and consumers.

Tuberculosis was encountered in 0.6 % sheep and 3.2 % goats. The incidence in goats is quite alarming as this was also encountered in the generalised form.

indicative of probable spread of infection from these animals to man by meat handling and eating of uncooked or partially cooked meat.

More number of abscesses of bacterial origin were encountered in sheep than goats probably because sheep is more prone to infection due to its wool resulting in comparatively more injury, predisposing bacterial invasion.

In total 254 abscesses from sheep and 248 from goats collected from different locations were examined. The examination revealed that abscess of lymph glands were harbouring more pathogens than those in the other locations, concluding this to be of haemopoitic infection. Most of abscesses contained staphylococci, causative of food poisoning which pass from the abattoir unnoticed causing harm to the consumers. These abscesses also result in the economic loss besides affecting the wholesomeness of meat.

In total meat samples from 8 sheep and 23 goats were examined on different advocated media which revealed haemolytic staphylococci in 3 out of 16 lymph glands, 4 out of 8 muscles and 1 out of 3 spleen in sheep while clostridium was observed in 5 out of 16 lymph nodes, 5 out of 8 muscles and 4 out of 8 spleen. Salmonella was

suspected only in 1 out of 16 lymph nodes and 0 muscles, cultured together.

In goats haemolytic staphylococci were isolated in 13 out of 56 lymph nodes, 9 out of 29 muscles and 4 out of 29 spleens; clostridium in 15 out of 56 lymph nodes, 13 out of 29 muscles and 10 out of 29 spleens; bacillus subtilis was recovered in 3 out of 56 lymph nodes, 2 out of 29 muscles and 1 out of 29 spleen. salmonella was suspected in 17 out of collective sample of 56 lymph nodes and 29 muscles, 11 out of 29 spleen and 11 out of 29 livers.

The above finding is of much economic importance and advocates proper bacteriological examination of meat before it is allowed for human consumption.

A study of selected 75 white spotted kidneys from different apparently healthy animals was undertaken to establish the fact of latent leptospiral infection in sheep and goats. The kidney sections were stained by special method of staining by silver impregnation method. 5 kidney sections showed black clumps or spiras morphologically identical to leptospira whence changes associated with acute focal or chronic interstitial nephritis characterised by mononuclear infiltration especially on periglomerular and perivascular region with or without

interstitial fibrosis and inflammatory changes in the glomerular epithelium were observed. The absence of leptospira like organism in rest of the sections can be attributed to the disappearance because of antibody reaction in the tubules just after death of the animal.

This observation is also of much zoonotic importance due to the acute infectious nature of leptospira in the human being.

BIBLIOGRAPHY

REFERENCES

*
Abdon, A.M. 1965 Importance of hydatidosis in middle east with special reference to UAR. J. Vet. Sci., UAR. 2: 125-135 (En).

Adinarayan, N., Jain, M.C., Chandiramani, N.K. & Majeld S.K. 1960 Studies on leptospirosis among bovines in India. Indian Vet. J. 37: 251-253.

Agarwal, S.C. 1963 Salmonella species prevalent in India. Bull. Wld. Hlth. Org. 29: 113-117.

Ahmed, S.M. 1948 Meat inspection in India Command J.R. Army Vet. Corps. 19: 72-75.

Albertsen, V.E. 1957 Meat Hygiene, W.H.O. monograph series No. 33, Wld. Org. Palais Des Nations, Geneva. 537 pp.

*
Allison, V.D., Hobbs, B.C. & Martin, P.M. 1969 A widespread outbreak of staphylococcal food poisoning. Mon. Bull. Min. Hlth. Publ. Hlth. Lab. Serv. 8: 36-47.

Alston, J.M. & Broom, J.C. 1958 Leptospirosis in Man and Animals. 1st Edition, E & S. Livingstone Ltd., Edinburg & London. 367 pp.

Anon 1955 First report of Joint FAO/WHO Expert Committee on Meat Hygiene. Wld. Hlth. Org. Palais, Des Nations, Geneva. 52 pp.

* Abstract only seen. Complete paper inaccessible.

Ahmon 1955 Agricultural marketing in India. Marketing series No. 72, Dirs. of Food and Agriculture, Government of India. 29 pp.

_____ 1960 Tuberculosis in domestic animals other than cattle. Br. Vet. J., 116: 193-199.

_____ 1967 First report of Joint FAO/WHO expert Committee on Zoonoses. Wld. Hlth. Org. Palais. Des Nations, Geneva. 120 pp.

_____ 1960 Report, National Seminar on Zoonoses in India Oct. 5-10. WHO., Delhi.

* _____ 1969 Fasciola hepatica in man. Br. Med. J. 1 (5641): 62.

*Artioli, D. 1959 Meat as source of Salmonella and staphylococcal gastroenteritis in man. Nuova Vet. 35: 160-166.

Ayres, J.C., Ogilvy, W.S. & Stumbo, C.F. 1950 Post mortem changes in the stored meat Micrororganisms associated with development of slime on eviscerated cut outpoultry. Food Technol. 4: 199.

Ayres, J.C. 1956 Microbial implications in the handling, slaughtering and dressing of meat animals. Adv. in Food Res. 6: 109.

*Bears, O. 1941 The nature of meat and food poisoning by Salmonella Dserh. Klerantl. Vschr. 49, 4-6.

* Abstract only seen. Complete paper inaccessible.

*Babudieri, B. & Gaspardis, D.	1961	Significance of low titres of *Leptospira* aglutinins in the serum of apparently healthy cattle zentbl. Vet. Med. 12B: 291-297.
Bell, G.B.	1970	Thesis, M.S., University of Missouri.
*Bartel, H.	1939	Salmonella typhimurium infection in man. Tierarztl. Rdsch. 45: 416-417.
Beamer, P.D., Hardenbrook, H. & Morrill, C.C.	1953	Studies on leptospirosis in domesticated animals. I- leptospirosis in sheep. Vet. Med. 48: 365. (Cited by Alston & Broom, *loc.cit.*
Bendenu, P.	1969	Liver fluke in humans, Vet. Rec. 85: 532-533.
*Beverley, J.K.A.	1960	Congenital *Toxoplasma* infection Proc. R. Soc. Med. 53: 111-113.
Bhatia, B.L. & Agarwal, R.S.	1967	An outbreak of S. *typhimurium* infection in Delhi. Indian Jour. Med. Res. 54: 33-38.
*Blair, J.E.	1939	The pathogenic *Staphylococci* Bact. Revs. 3: 97-149.
Brown, A.D. & Weidman, J.F.	1958	The taxonomy of Psychrophilic meat spoilage bacteria - a reassessment. J. appl. Bact. 21: 11.
*Brigge, G.	1944	Echinococci in the lungs and associated lymph nodes of sheep. Z. Fleisch- Milch hyg. 54: 145-147.

* Abstract only seen. Complete paper inaccessible.

Bundin, M.L., Freyd, G. & Ashford, W.A. — 1950 — Leptospirosis in Kenya due to Leptospira ictero-haemorrhagiae. Vet. Rec. 70: 830.

Burgdon, P. — 1960 — The major cause of condemnation of meat in New South Wales, Australia. Aust. Vet. J. 16: 113-117.

Burton, A. — 1957 — Salmonellosis in animals - a review. Commonwealth Agricultural Bureaux, Farnham, Royal Bucks, England. 209 pp.

Carlton, H.M. — 1937 — Histologic technique XII Edition. Oxford Uni. Press, London.

Carter, H.H., Hubanks, P.E., Mann, M.D., Alexander, L.M. & Schneyer, C.E. — 1948 — Effect of cooking on D.D.T. Contents of beef. Science. 107: 367.

Clapham, P.A. — 1942 — On identifying Salmonella spp. by measurements of large forms. J. Hyg. Camb. 39(1-2), 31-40.

* Cohrs, P. — 1941 — Differential diagnosis of miliary tuberculosis. Z. Fleisch -u. Milchhyg. 51: 141-143.

* ——— — 1943 — Meat hygiene problems concerning tuberculosis. Z. Fleisch-u.-Milchhyg. 53: 131-135.

Collins, F.V. — 1939 — Miscellaneous notes & queries on meat inspection in South Australia. Aust. Vet. J. 15: 94-103.

* Abstract only seen Complete paper inaccessible.

Cordon, R. 1949 Sterilization of Salmonella infected meat by boiling steak. Microbiol. Monthr. 25: 245-249.

Cruickshank, R. 1965 Medical Microbiology Eleventh Edition English language book Society. 1067 pp.

Das Gupta, B.M. 1939 Further observations on leptospiral infection in Calcutta. Ind. med. Gaz. 74:31. (Cited by Alston & Broom loc. cit.)

Feodhar, N.M. & Narangur, V.B. 1965 'Pneumonitis Cysticercosa' - A new disease condition of goat caused by migrating cysticercus tenuicollis in the lung. Indian Vet. J. 42: 202-204.

Doorani, V.P. Sharma 1967 Histopathological studies on Hepatitis cysticercosa lesions in sheep and deer. Indian vet. J. 44: 939-942.

Khandhare, N.R., Bhagwat, R.B., Salnani, G.S., Deshmukh, P.V., Patil, S.D. & Gargani, L.J. 1966 An outbreak of brucellosis in a family Indian J. med. Sci. 19: 145.

Holman, C.R. 1943 Bacterial food poisoning. Canad. J. Publ. Hlth. 34: 285-295.

Hrabble, J. 1964 Text book of Meat Inspection. 5th Ed. Angus & Robertson Ltd. 89, Castle Reagh Street, Sydney. 414 pp.

Hurbin, C.C. 1957 Public health significance of antibiotics in food. J. Am. Vet. med. Ass. 130: 230-232.

* Abstract only seen. Complete paper inaccessible.

D'Souza, T.J., Collee, J.G. & Shah, J.M. 1968 Report on an outbreak of acute bacterial poisoning. Indian J. Path. Bact. 2: 223.

Edelmann, R., Mohler, J.R. & Eichhorn, A. 1939 Meat hygiene, 7th Edition. Lea & Febriger, Philadelphia. 461 pp.

Edwards, P.R. & Ewing, W.H. 1962 Identification of Enterobacteriaceae, 2nd Edition, Communicable disease Centre, U.S. Publ. Hlth. Service, Atlanta, Georgia. 232 pp.

* Empey, W.A. & Vickery, J.R. 1933 Use of carbon dioxide in the storage of chilled beef. J. Council Sci. & Ind. Res. (Aust.). 6: 293.

Empey, W.A. & Scott, W.J. 1939 Investigation on chilled beef. Part I Microbiological contamination acquired in the meat work. Aust. Council Sci. & Ind. Res. Bull. No. 126. (Cited by Ball, O.S. 1970) (loc.cit.)

Esty, J.R. & Meyer, K.F. 1922 The heat resistance of the spores of B. botulinum and allied anaerobes. J. Infect. Dis. 31: 650.

* Farina, R. & Nduro, L. 1960 Serological survey for leptospirosis in cattle, goat & camels in Somalia Sooprofilaxi. 15: 925.

Ferguson, L.C. 1950 Diseases of swine. Iowa State University Press.

Francis, J. 1955 Tuberculosis in animals and its transmission to man. Vet. Rec. 71: 474-476.

_____ 1967 Zoonoses and Public Health. Aust. Vet. J. 43: 311-319.

* Abstract only seen. Complete paper inaccessible.

*
Fukumoto, T., Koshimizu, K., Kamal, T., Maruda, T., Nakamura, T., Sugaya, S., Saito, K. & Tokutomi, C.

1964 An experiment on heat resistance of Toxoplasma in meat. J. Japan. Vet. med. Ass. 17: 25-27.

*
Fuchy, C.

1939 Helminthiasis in Hungary Mol. Pathol. I. (orig.) 142: 137

*
Gabrial, A.

1957 Hydatid cyst of liver. Cey. Med. J. 6(2): 61-64.

Galton, M.M., Lowery, V.D. & Hardy, A.V.

1954 Salmonella in fresh & smoked pork sausage. J. Infect. Dis. 95: 233-234.

Ganguli, S.

1958 Salmonella serotype in India. Indian J. Med. Res. 46: 637-642.

Ganguli, S. & Aroyyadoss, S.

1956 Salmonella Paratyphi in Madras. Indian J. Med. Res. 44: 181.

Garnham, P.C.C. & Lainson, R.

1960 Sheep as potential reservoir of Toxoplasma Lancet July 9th. 71-74.

Gammel, M.A.

1958 Hydatid disease in Australia. Aust. vet. J. 34: 138-143.

1959 Hydatid disease in Australia. Aust. Vet. J. 35: 113-117.

* Abstract only seen. Complete paper inaccessible.

Gemmel, M.A. 1961a An analysis of incidence of hydatid cyst (E. granulosus) in domestic food animals in Newzealand, N.Z. Vet. J. 9: 29-37.

——— 1961b Some observations on the differences in the incidence between E. granulosus and E. hydatigena in liver of sheep in New Zealand. N.Z. vet. J. 9: 40-41

Gerrard Frank 1964 Meat Technology 3rd Edition. Leonard Hill, London. 352 pp.

*Gordon, L.M.G., Davos, A. & Davos, N. 1949 Meat poisoning caused by Salmonella group. Vlaar Diergeneesk. Tijdschr. 18: 173-176.

*Grunberg, A. 1956 Incidence of hydatidosis in Kenya slaughter animals. East Afr. Ind. J. 33: 297-300.

Grunberg, A., Mil, E.C. & Grieve, J.M. 1957 Oxytetracycline and its use as a meat preservative in underdeveloped countries. Vet. Rec. 69: 993-999.

*Groh, K. 1939 Simultaneous occurrence of human and bovine type bacillus in bovine tuberculosis. Z. Hyg. Infekt Kr. 122: 62-71.

*_____& Nemeto, S. 1939 Simultaneous presence of human and bovine type bacilli in kidney tuberculosis in man. Zbl. Bakt. 1: 335-344.

*Gron, C.E. & Vinton, C. 1947 Thermal death time of strain of staphylococcus in meat. Food Res. III. 12: 188-202.

* Abstract only seen. Complete paper inaccessible.

*Gruttner, F.	1944	Liver fluke & meat poisoning. Z. Fleisch. u. Milchhyg. 54: 133-135.
Halme, K.B.	1932	The bacteriology of commercial poultry processing. Burgess Pub. Co., Min. Minnesota-7.
----------	1937	Microbiology in the preservation of animal tissue. Dep. Sci. Ind. Res. Food Invest. Board Report No. 41. London. (Cited by Hall, H.C. 1950) loc.cit.
*Haklioglu, V.	1955	Leptospirosis histologically confirmed in sheep and goat in Turkey. Mol. allg. Path. path. Anat. 95: 525-527.
Hall, H.C.	1993	Flukes & tapeworms of cattle, sheep and swine with special reference to infection of meat. Bur. Animal Industr. U.S. Deptt. Agri. 19: 11-136. (Cited Southwell, Dec., 1930. loc. cit.)
----------	1916	A new & economically important tapeworm, Multiceps cadcardi from dog. J. Am. Vet. Med. Ass. 50: 214-223.
*Havnor, O.M., Trevting, H.L. & Breitfeln, L.A.	1945	An outbreak of food poisoning due to a new etiological agent Salmonella berta. Publ. Hlth. Rep. Wash. 60: 1138-1142.
Hayes, W. & Freeman, J.F.	1945	The incidence and type of bacteriology of Salmonella infection in Army in India. Ind. Jour. Med. Res. 33: 177.
Heidrich, D.	1963	Comparative evaluation of tetrathionate broth & Selenite broth for demonstration of Salmonella in bovine faeces & in bacteriological meat inspection. Dtsch. tierarztl. Wschr. 70: 598-601.

* Abstract only seen. Complete paper inaccessible.

Haydon, C.A.M. & Beveridge, A.J.	1939	A further case of human infection with Trichostrongylus Columbriformis in new South Wales. Med. J. Aust. May 6th. 694-695.
*Haydt, R.	1952	Inspection of organs infected with D. lanceolatum. Lebensmittel. Tierarzt. 1: 23-27.
*Hobbs, B.C. & Wilson, J.G.	1939	Contamination of wholemeal meal supplies with salmonellae and heat resistant Clostridial welchii. Rep. Bull. Minist. Hlth. Lab. Serv. 18: 198-206.
Hoeden, J. Van Der	1953	Leptospirosis among goats in Israel. J. Comp. Path. 63: 101.
*Hübner, K.	1933	Localised eosinophilia causing discolouration in the organ of our food fish. Infekt Kr. Haust. 42: 60-66.
Hull, T.G.	1955	Diseases transmitted from animals to man, 4th Ed. Charles C. Thomas Publisher, Springfield, Illinois, U.S.A. 717 pp.
Inada, K., Ido, Y., Hoki, R., Kaneko, R. & Ito, H.	1916	The etiology, mode of infection and specific therapy of Weil's disease (Spirochaetosis icterohaemorrhagica). J. exp. med. 23: 377. (Cited by Alston & Broom, loc. cit.)
Iyer, P.K.R. & Nanda, V.P.	1965	Observation of white spots in kidney of goat. Indian Vet. J. 42: 567-70.

* Abstract only seen. Complete paper inaccessible.

Jensen, L.B. 1944 Prevention of bacterial food poisoning by food preservation. J. Am. Vet. med. Ass. 104: 63-65.

_____ 1954 Microbiology of meats. 3rd Ed. Garrard Press, Champaign, Illinois. 422 pp.

_____ & Hess, W.R. 1941 A study of ham souring food Res. 6: 273.

Johari, L.N. 1967 On occurance of larval form hydatid cyst (E. granulosus, Batsch, 1936) from sheep of Delhi state. Proc. of National academy sci. India section B. 37: 59-61.

* Johns, A.W. 1951 Food poisoning from central school's children. No 1. Offr. 16: 89-96.

* Jones, A.C. & Symons, A.D. 1940 An outbreak of food poisoning due to S. dublin. Minist. Hlth. Publ. Hlth. Lab. serv. 7 (September) 202-206.

Jones, I. & Smith, P. 1964 Liver fluke infection in man. Heat Hyg. Mva. 5: 1.

Joseph, P.M. & Vaira, L. 1966 Leptospirosis in India. Indian J. Med. Res. 54: 611-614.

Joshi, D.V. & Om Prakash. 1971 Prevalence of brucellosis in man and animals. Indian J. Path. & Bact. 14: 96.

* Kampe, A. 1949 Food poisoning and staphylococcus enterotoxin. Skand. Vet. Tids Kr. 39: 193-201. (English Summary).

* Abstract only seen. Complete paper inaccessible.

Kendall, S.B. 1955 Fascioliasis in Pakistan. Ann. trop. med. & Parasit. 49: 307-309.

Kenneth, M., Wally & Schnitzer, M.G. 1970 Public health aspect of toxoplasmosis. J. Am. Vet. Med. Ass. 151: 1779.

Khanna, K.S. & Iyer, P.K.R. 1971 A case of Haemonchus Contortus infection in a goat. Indian J. med. Res. 59: 993.

Kharole, M.V. & Rao, V.K.R. 1960 Leptospirosis in cows in India. Indian Vet. J. 43: 14-19.

Khera, S.S. 1962 Animal salmonellosis in India. Indian J. Med. Res. 50: 559-579.

_____ 1960 Zoonoses in India. Indian Vet. J. 45: 911-915.

Kirsch, R.N., Berry, P.T., Baldwin, C.L. & Foster, E.M. 1952 Bacteriology of refrigerated ground beef. Food Res. 17: 495.

*Klein, H. & Hanse, H. 1959 Mammals, epidemiology and meat inspection aspect of tuberculosis in sheep. Mh. Vet. Med. 13: 619-622.

*Klimesch 1937 An extensive outbreak of meat poisoning. Berl. tierarztl. Wschr. July 23rd: 465-469 & 470-478.

* Abstract only seen. Complete paper unavailable.

Kolobolotzki, O.V. 1938 Determination of bacterial contamination of meat by an oxidising colour reaction. Veterinariya Moscow. 11 (8). 36-42 pp.

Kosilov, I.A. & Maleenkaya, L.I. 1962 Survival of brucella in mutton veterinariya Moscow No.1; pp. 63-64.

*Kotova, O.M. 1955 Treatment of carcasses of animals with leptospirosis - Survival of leptospira in meat. Trud. voronezh Oblast. nauchno-issled. vet. Opyit. Stantsi. No.1: pp. 129-132.

Krishna Iyer, P.R. 1940 Tuberculosis in monkey caused by bacilli of bovine type. Indian J. vet. Sci. 10: 271-278.

_____ 1944 Tuberculosis in goats. Indian J. Vet. Sci. 14: 100-111.

*Kurnoja, V. 1957 Brucellosis in veterinary, zoo-technical, milk and meat industry. personnels. Med. Vet. Ve sovie. 12: 331-332.

Lechnerthald, B. 1931 The Veterinary surgeon & paratyphoid. Deutz. tierar. wbl. Woche. 39: 764-769.

Lall, J.M. 1960 Tuberculosis among animals in India. Vet. Bull. 29: 385-390.

Langham, R.F., Morse, E.V. & Porter, R.L. 1959 Pathology of experimental ovine leptospirosis. J. infect. Dis. 103: 285-290.

* Abstract only seen. Complete paper unobtainable.

Lawrie, R.A. 1966 Meat Science. Pergamon Press. N.Y.

*Leistner, M. 1960 Brucellosis and meat hygiene. Mh. vet. med. 15: 603-605.

*Levine, M.G. 1943 Brucellosis in packing house workers. J. Indust. Hyg. Toxicol. 25: 451-452.

*Lillengor, K. 1945 Pollution of meat abattoir apparatus and premises with tubercle bacilli due to carcasses with tubercle bacilli on the serous surface. Svenska Jan garesord. Medicl. 19: 1-27 (English Summary).

Lockhead, A.G. & Landerkin, G.B. 1935 Bacteriological study of dressed poultry. I. preliminary investigation of bacterial action at chill temperature. Fed. Agri. 15: 765.

Lopovetsky, B.C., Wolner, H.H. & Mathrage, F.E. 1953 A microbial study of lymph nodes, bone marrow and muscle tissue obtained from slaughter cattle. Appl. Microbiol. 1: 57-59.

Lovell, R. 1932 The reaction of meat and meat products to bacterial food poisoning in man. Vet. Rec. 12: 1052-1065.

* 1957 Food poisoning in man with special reference to meat and meat products. Roy. Soc. Hyg. J. 77. 95-91.

* Lubanetsky, S.A. 1949 Inspection of meat infected with leptospira veterinaya Moscow. 26 No. 9. 52-59 pp.

* Abstract only seen. Complete paper inaccessible.

Luna, M.L.G. 1968 Manual of Histologic staining method of armed forces institute of Pathology. IIIrd Ed.

Malhotra, S.K. 1969 M.V.Sc. thesis, Agra University.

Marwaha, D.K. 1966 Some aspects of meat trade in India. Indian J. Anim. Health. 5: 163-166.

Mathur, T.V. 1959 An outbreak of food poisoning in a family due to S. <u>wassenaar</u>. Indian J. med. Res. 47: 367.

——— 1959b Some further observations on brucellosis among children. Indian J. Child Hlth. 8: 13.

——— 1959c Strains of <u>brucella melitensis</u> isolated at Karnal. Indian J. med. Res. 47: 363.

——— 1963 <u>Brucella</u> strains isolated from animal and human sources at Karnal and Bhiwani, Punjab. Indian J. med. Res. 51: 899.

——— 1964 <u>Brucella</u> strains isolated from cows, buff., goat, sheep and human beings at Karnal - their significance with regard to the epidemiology of brucellosis. Indian J. med. Res. 52: 1231.

——— 1965 The epidemiology of human brucellosis in Haryana with regard to 315 strains of brucella isolated from men & animals. Indian J. Path. & Bact. 8: 244.

* Mc Cristall, F.	1966	New Zealand national hydatid council. Sixth Annual Report & statement for account for the year ending 31.3.66. 44 pp.
Mc Donald, A.	1945	Food poisoning J.R. Sanit. Inst. 65: 171-174.
* Morlo, A.	1959	Salmonellosis in animals in relation to human infection. Bull. Off. Intl. Epiz. 52: 441-492.
* Meyer-Holmstedt, F.	1950	Food poisoning caused by Salmonella breslau. Lebensm. Hygiene. 1:116-118.
Miller, A.R.	1963	Meat hygiene, Second Edition, Lea & Febiger, Philadelphia. 557 pp.
Mitchell, J.R.	1963	Meat borne zoonoses in East Africa. Vet. Bull. 33: 1-5
* Moorehead, R. & Wolmer, M.N.	1946	The survival of staphylococcal food poisoning strain in the gut and excreta of the house fly. J. Milk Technol. 9: 253-259.
Morse, E.V. & Langham, R.F.	1959	Experimental leptospirosis. III. Caprine leptospira pomona infection. Am. J. Vet. Res. 19: 139-144.
Mundt, W.	1956	Brucellosis and meat inspection. Berl. Munch. Tierarztl. Wschr. 69: 397-400.
Nanda, P.N. & Gopal Singh	1949	Tuberculosis in goats at the Govt. Cattle Farm, Hissar. Indian J. vet. Sci. 13: 70-74.

* Abstract only seen. Complete paper inaccessible.

Handa, P.N. & Karmail Singh	1944	A case of tuberculosis in sheep. Indian J. vet. Sci. 14: 110-111.
Narayan, K.G.	1967	Incidence of Clostridia in meat animals. Indian vet. J. 44: 633-640.
Nath, M.L., Srivastava, J.B., Sethi, S.K. & Singh, J.A.	1966	Salmonella Pattern in India. Indian J. med. Res. 54: 513-516.
* Nieles, A.	1937	Examination of healthy slaughter animals at Dortmund abattoir for bacteria of enteritis group. Inaug. Diss. Berlin. 22 pp.
Paliwal, O.P. & Singh, K.P.	1971	An outbreak of acute Coenurosis in sheep - a Pathological study. Indian Vet. J. 48: 793.
Panda, P.C. & Sekariah, P.C.	1940	Studies on leptospirosis among goats in India - Isolation of an incomplete biotype of L. pomona. Proc. Indian Sci. Cong. Part III. 27: 311.
Pandey, V.S.	1971	Observation on Echinococcosis in Bihar. Indian J. Anim. Sci. 41(7): 596-599.
Pargaonkar, V.N. & Rama Krishna, K.	1963	Leptospirosis in sheep and goat in Andhra Pradesh. Indian vet. J. 41: 441-445.
* Paul, A.T.S.	1957	Hydatid disease of lung and liver. Cey. Med. J. 4: 65-69.
* _____ & Fernandom, M.	1957	Hydatid disease in Ceylon. Ibid. 51-59.

* Abstract only seen. Complete paper inaccessible.

*Fuhrer, H. 1944 Meat poisoning by B. abortus. Z. Fleisch-u. Milchhyg. 54: 91-93.

*Petri, K. 1940 Tuberculosis in goats seen at meat inspection at Frankfurt on main. Tierarztl. Rdsch. 46: 602.

*Piacenti, P. 1959 Leptospirosis in sheep - experimental infection with L. interrhaemorrhagiae. IV-lesion. Ann. Fac. med. vet. Pisa. 12: 42.

*Pigeury, L. & Nizan, P. 1954 Radio active contamination of meat and possibility of salvage of affected meat, with particular reference to radio active phosphorus. Rec. Med. Vet. 130: 434-440.

Prakash, S., Ghose, J.N. & Varmani, D.M.L. 1967 E. granulomus infection in man and animals in and around Delhi with a brief view of work done in India. Bull. Ind. Soc. Mal. Comm. Dis. 4: 174-183.

*Prokhorov, M.I. 1941 Bacterial flora of meat of animals slaughtered in emergency. Veterinariya. Moscow No.1. 93-99 pp.

Purdy, M.J. 1955 Ref. N.Z. med. J. 54: 572-578.

Radhey Mohan. 1950 Incidence of tuberculosis in goats. Indian Vet. J. 27: 153-157.

Randhawa, A.S. & Malik, D.S. 1964 Human Pathogens from goat meat - brucella. Indian J. Med. Res. 52: 187.

* Abstract only seen. Complete paper inaccessible.

Randhawa, A.S. & Kolte, D.S.	1970	Human pathogens from goat meat - Brucella. Ibid. 59: 181.
Rao, S.R.	1970	Bacteriological quality of comminuted meat. Indian Vet. J. 47: 637.
* Rigdon, R.H.	1939	Experimental nephritis produced by Staphylococcal toxin in the dog. J. lab. clin. med. 24: 935-943.
* Rocher, M.L. & Laporte, R.	1938	Role of bovine type tubercle bacilli in tuberculosis in man. C.R. Biol. Paris. 127: 266-268.
* Saenz, A.	1938	Role of bovine type bacillus in T.B. in children and adults. Ibid. 269-272.
Sayed, S.A., Parikh, N.V. & Patil, M.A.	1962	Hydatid cyst in kidney. J. Ind. Med. Ass. 39: 547.
Schantz, P.M. & Schwabe, C.W.	1969	World wide status of hydatid disease control. J. Am. vet. med. Ass. 155: 2104-2121.
* Schellner, H. & Nolgeler, A.	1935	Suitability for human consumption of meat from animals poisoned with arsenic Dtsch. tierarztl. Wschr. 43: 431-433.
* Schmey, M. & Bugge, G.	1931	On the vitality of cysticerci. Berl. tierarztl. Wschr. 47: 193-199.
* Schoof, G. & Lovenmen, F.	1938	Anaerobes in bacteriological meat inspection. Dtsch. tierarztl. Wschr. 46: 209-215.

* Abstract only seen. Complete paper inaccessible.

*Scott, W.J. & Stewart, D.F.	1943	An outbreak of food poisoning due to staphylococci Med. J. Aust. Sept. 11th: 211-212.
Seibold, H.R., Keech, Norbert & Bohlman, D.L.	1961	Histopathological and serological study of subclinical leptospirosis among cattle. J. Am. Vet. Med. Ass. 139: 424.
*Sekulovic, P.	1960	Cysticercosis, fascioliasis and Echinococcosis in slaughter animals in Srna Gora - Vet. Glasn. 12: 395-397.
*Seltzer, W. & Schwarzmann, E.	1937	Occurrence of tubercle bacilli in healthy organs and importance of this fact in meat inspection. Z. Hyg. Infekt. Kr. 119: 617-622.
Selvaraj, K.M.	1967	M.V.Sc. dissertation, Madras University.
*Sen Gupta, D.N., Talapatra, N.C. & Lahiri, M.M.	1961	S. heidelburg in rural areas in West Bengal. Indian J. Publ. Hlth. 5: 61.
*Sensi, P.	1953	Incidence of leptospirosis of sheep and goat in Tuscany. Ital. Ann. Fac. Med. Vet. Pisa. 10: 117-132.
*Sethi, S.K., Nath, M.L. & Srivastava, J.B.	1968	Prevalence of Salmonella serotypes in sheep and their significance to Public health. Indian J. Publ. Hlth. 12: 211-214.
Sharma, R.N. & Brahma Dutt.	1970	Histopathology of white spots in caprine kidneys. Indian J. Ani. Sci. 40: 518.

* Abstract only seen. Complete paper inaccessible.

Glomicki, W., Prazlecki, S., Daan, I., Cyganiewicz, W., Plorz, J. & Radnieszowska, D.	1960	Brucellosis in Dairy and Meat workers in Poland. Med. Vet. Warszawa. 16: 267.
Singh, P.N. & Kuppuswamy, P.P.	1969	Pathology of hydatidosis in caprine liver. Indian J. Anim. Hlth. 8: 191-193.
Skovgaard, N.	1969	Notes provided at FAO/WHO training centre on meat hygiene, Denmark. 27th July to 6th September. 33 pp.
Sleight, S.D., Langham, R.F. & Porter, R.L.	1960	Experimental leptospirosis - the early pathogenesis of Leptospira pomona infection in young swine. J. Infect. dis. 104: 262-269.
Smith, C.E.G., Turner, L.H., Harrison, J.L. & Brown, J.C.	1961	Outbreak of leptospirosis in Malaya. Bull. of Wld. Hlth. Org. 1: 5-21.
* Smith, H.G.H.	1964.	Salmonella in abattoir, butchers shop and home produced meat and their relation to human infection - Report of working party of the public health laboratory service. J. Hyg. Camb. 62: 293-302.
Smyth, J.D.	1964	Biology of hydatid organism. Advances in Parasitology. Vol. 2. 160-215 pp. (Academic Press, London and N.Y.)

* Abstract only seen. Complete paper insuccessible.

Soulsby, E.J.L. 1965 Helminth, Arthropods & protozoa of domesticated animals. 6th Ed., Balliere, Tindall & Cassell Ltd., London. 825 pp.

_____ 1965 Text book of Veterinary Clinical Parasitology. Vol. I. Blackwell Scientific publication Oxford. 1120 pp.

Southwell, T. 1930 The fauna of British India. Vol. II. Cestodes. 362 pp. Taylor & Francis, Red Lion Court Fleet Street, London.

* Spencer, H.A. 1943 Diseases caused by eating uncooked flesh of dead animals. S. Afr. med. J. 16: 367-369.

Stringer, W.C., Bilskie, M.E. & Neumann, H.D. 1959 Microbial profiles of fresh beef food Technol. 22: 97.

* Stura, C.A. 1943 Identification of pathogenic & saprophytic bacteria in meat and meat products. Gac. vet. B. Aires. 5: 323-340.

* Suarna, M. & Nethoke, H.J. 1957 The meat inspection aspect of bovine brucellosis. Tierarztl. Umsch. 12: 218-221

Sutherland, A.K., Simmons, G.C. & Kenny, G.C. 1949 Bovine leptospirosis. Aust. Vet. J. 25: 197.

* Tamagaki, L., Simmons, G.C., Mc Gavin, M.D. & Ludford, G.O. 1961 Experimental infection of boars including studies on transmission of infection by coitus. Od. J. Agric. Sci., 19: 231-240.

* Abstract only seen. Complete paper inaccessible.

Taylor, J. & Doyle, A.M. 1931 Leptospirosis in Andamans. Indian med. Res. Mem. No. 20. 12 pp.

Thornton, H. 1957 Text book of meat inspection. 3rd Ed., Bailliere, Tindall & Cox. 7 & 8 Henrietta street, W.C. 2. 392 pp.

_____ 1958 Problem of slaughter and for their inspection and the need for their investigation by research worker. Part I & II. B. Vet. J. 114: 164-176 & 230.234.

Tomar, D.S. 1959 Studies on caprine kidney. M.V.Sc. Thesis, Agra University. Agra.

* Trawin'ski, A. 1937 Meat inspection and diseases found in slaughtered animals in Poland. Z. Fleisch-u-Milch hyg. 47: 298-299.

* Verge, J. 1931 Combined tenemias & infections in man due to ingestion of contaminated meat: Bacteriological examination of meat. Rec. Med. Vet. 107: 804-851.

* _____ & Thouin, G. 1932 Bacteriological examination of meat evidence of food poisoning bacteria in Pork. Rev. Gen. Med. Vet. 41: 1-11.

* Vale, E. 1959 Action of Aerobic sporeforming organisms on muscle pigments. Arch. Lebensmittel hyg. 2: 200-201.

* Abstract only seen. Complete paper inaccessible.

Wardle Robert, A. & Archie Mc Leod James 1952 The zoology of tapeworms. 1st Ed.

*
Weil, A. 1886 Ubereine eigentumliche, mit Milztumor, Icterus, and nephritis einhergehende akute Infektions. Krankheit. Dtsch Arch. Klin. Med. 39: 209.
(Cited by Alston & Broom, loc.cit.)

Yadav, N.P. 1971 M.V.Sc. Thesis, Agra University, Agra.

* Abstract only seen. Complete paper inaccessible.