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ANIMAL INDUSTRY ITS WASTE (MANURE), HUMAN HEALTH AND ENVIRONMENTAL CONCERNS

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SUMMARY : *There is a very close connection between food/feed and wastes. Since the wolrd's human and animal populations are increasing, this irreversible trend with inputs of food/feed and output of wastes occurring in an alarming amount is directly affecting waste (manure) disposal problems in both rural and urban areas. It has been estimated that global annual animal waste (manure) is to be over 1, 188 billion tons, and 2.0 billion tons is produced in the U.S.A. alone. As a result of rapid growth of the animal industry, most of the livestock operators are faced with the problem of disposing waste quantities of animal manure and litter. The traditional method of disposing animal wastes and poultry litter has been to spread it on the land because of their excellent fertilizing properties. This paper describes the health hazards and safety considerations occurring from animal wastes and upgrading animal waste into food, feed, fuel and fertilizer to reduce environmental pollution. Public health implications and socio-economic pressure coming from the use of animal waste in those areas are also discussed briefly. It has been concluded that public pressure against pollution is hence a real and justified factor in promoting utilization of manure in different agricultural operations.*

HAYVANSAL ARTIKLARIN (HAYVAN GÜBRESİNİN) ÇEVREYE, ÇEVRE KİRLİLİĞİNE VE İNSAN SAĞILINA ETKİSİ

ÖZET : *Yiyecek (yem) ile hayvan gübresi arasında sıkı bir ilişki mevcuttur. Dünyada insan ve hayvan populasyonları sürekli bir artış göstermekte, bunun sonucu olarak tüketilen yiyecek veya yem miktarı artmakta ve buna paralel olarak ta hem kırsal kesimde, hem de şehirlerde sorun haline gelmektedir. Dünyada bir yılda 1.188 milyar ton hayvansal gübrenin üretildiği tahmin edilmektedir ki bunun 2 milyar tonu tek başına A.B.D.'ne aittir. Hayvansal endüstrideki hızlı gelişme sonucu hayvan yetiştiricileri büyükbaş hayvan ve tavuk gübresinin eliminasyonu sorunu ile karşı karşıya kalmışlardır. Toprak için mükemmel gübreleme özelliklerinden dolayı, büyükbaş hayvan ve kanatlıların gübresi şimdiye kadar geleneksel olarak araziye atılagelmiştir. Bu makalede, hayvan gübresinin sağlık yönünden ortaya çıkardığı sakınca ve tehlikeler ile güvenlik önlemlerinin yanısıra, bu hayvansal artıkların kullanılmasının halk sağlığı ve sosyo-ekonomik boyutları kısaca ele alınmıştır. Birçok zirai faaliyetlerde gübrenin kullanımını teşvik etmede halkın tepkisi çevre kirliliği yönünden gerçek ve haklı bir faktör olarak ortaya çıkmaktadır.*

INTRODUCTION

Over the past two decades, public and govermental awareness of environmental problems has grown steadily in the regulation of point of sources of pollution. The traditional regulatory approaches to environmental pollution have focused primarily on protecting the maximally exposed individual areas located in the immediate vicinity of the pollution source close to urban areas. Unfortunately, the attitude towards overcoming those problems is generally quite small; either nothing is done to remedy the damage to the environment and to the population or, if action is taken, it is motivated by only absolute necessity and it is taken only with hesitation because it is a burden on the industry itself and also on the public purse.

Today we face global environmental problems that are both serious and complex. Generally stated, these include:

a. Soil erosion.
b. Loss of genetic resources.
c. Defrostation.
d. Desertification.
e. Population.
f. Air/water/land pollution.

One current environmental topic that has attracted more than its share of misconception is the seemingly prosaic subject of garbage and landfills. McCurdy (1990) indicated that we are creating more solid waste per capita today than eight years ago. It is completely true; however this statement leads to another issue: what can be done about waste produced by the animals, poultry and livestock industry? It is a fact that little attention has been given to the global implications of the livestock industry and its waste. If the waste is produced and not destroyed naturally or by humans, it eventually reaches the environment and the population being exposed to trace levels of hazardous contamination.

In parallel with the industrial waste problem, occurring more recently is the increased production of agricultural wastes due to intensification of crop and animal production. Although the waste products of these industries are not classified as toxic in the normal senses of the word, when high accumulations occur, they can result in the same problems of water and land pollution encountered with factory pollution. Symptoms of those pollution are already appearing near high density animal stocking areas. For example, lakes and inland waterways have been subject to large scale eutrophication caused by animal manures trickling from the land which has been both biologically and physically overloaded.

The traditional method of disposing animal wastes has been to spread them on the land because of their excellent fertilizing properties. However, recently, some scientists became aware that access manure could be converted into assets. The development of upgrading methods for recycling of these wastes could alleviate the animal waste problems that any process developed was quick and environmentally liable.

This paper describes the health hazards and safety considerations occurring from animal wastes. There are numerous animal wastes produced by the industry, but we will focus on manure as a waste that interferes with human environment.

LIVESTOCK POPULATION AND ITS WASTE IN THE WORLD; IN THE U.S.A.

The need for increased food supplies and the magnitude of the need will depend on the status of human population and the standard of living and type of diet desired by that population. Other interacting factors affecting the human food supply will continue to be improved livestock production and reduction in table wastes and improved use of livestock waste products that have the potential either for improving crop production or being used directly or indirectly as food/feed or energy source.

Global livestock production and its productivity in developed and developing regions are given in Table 1 (FAO 1985). Muller (1980) estimated that the global volume of fecal wastes from broilers, laying hens and breeding chickens (excluding turkeys) is to be over 46 billion tons; turkeys about 2.6 billion tons; cattle almost 932 billion tons; buffalos almost 100 billion tons; and from pigs nearly 109 billion tons for a total of 1, 188 billion tons of animal wastes.

Wastage occurs at all points along food manufacture and in final consumption of food by people. More than 150 million tons of agricultural wastes such as oilseed hulls and corncobs which are cellulosic in nature are produced annually in the U.S.A. This figure does not include animal wastes. Sawdust represents and additional 40 million tons of material. Commercial production of vegetables contributes greater than 300 million tons of additional fresh solid wastes annually. Large numbers of livestock and poultry (Table 2 Agricultural Statistics, 1987) are raised in the U.S.A. resulting in over 2 billion tons of manure and litter being produced each year (Loehr 1979; 1977; Muller, 1980). Ledward, et al (1983) predicted that the wastes coming from different sectors (meat, dairy, poultry) of the livestock processing industries reaches 4.38 million lbs. daily, Biochemical Oxygen Demand (BOD) discharge.

Table 1. Productivity of Livestock Populations in Developed and Developing Regions.*

		% by region	
Item	World total	Developed	Developing
Cattle			
Inventory, 10^6	1.491	35	65
Meat, 10^6 Mt	46	71	29
Milk, 10^6	458	82	18
Sheep			
Inventory, 10^6	1.122	46	54
Meat, 10^6 Mt	6	56	44
Goats			
Inventory, 10^6	460	6	94
Meat, 10^6 Mt	2	6	94
Swine			
Inventory, 10^6	791	43	57
Meat, 10^6 Mt	58	61	39
Poultry			
Inventory, 10^6	8.287	47	53
Meat, 10^6 Mt	31	66	34

* Source : FAO (1985)

Table 2. Livestock and Poultry Population of the U.S.A.

Item	Population head
Cattle - buffalo, calves	102.468.000
Hogs	50.960.000
Sheep	10.328.000
Goats	1.950.000
Chickens	288.698.000
Turkeys	3.271.000
Broilers	4.478.749

Source : Agricultural Statistics (1987).

Low acceptability or palatability are limiting factors for those waste products of the livestock and poultry industry and also manure as a feed. However, in most cases, it is considered advisable to explore the potential for an upgraded waste product in the animal feed market first.

MANURE PRODUCTION IN DIFFERENT OPERATIONS AND THEIR CHARACTERISTICS

Categorically, wastes are classified as follows (Ledward, et al, 1983):

1. Avoidable waste that has no value,
2. Avoidable waste that has actual and potential value,
3. Unavoidable waste that has no value,
4. Unavoidable waste that has actual or potential value; so the livestock manure is one of these.

As a result of rapid growth of the industry, not only feedlot operators but also poultry and dairy operators are faced with the problem of disposing of vast quantities of animal waste and litter. For instance, 1972 figures indicate that the total feedlot manure amounts were about 28 million tons/year (Walawender, et al 1972). In 1992, it went up to 48 million tons which is excepted to increase to 1.0 million tons/year. Waste generation has been estimated 2 tons per head/per year of semicomposted manure containing about 50 % moisture.

There are obvious variations in the characteristics of wastes from livestock feeding operations. Animal feces frequently contains different feed additives to increase weight gains (Table 3, Church, 1986). Some of the additives are inhibitory to microorganisms or pathogens and considered pollutant (Fontenot and Jurubesen 1979; Zinn 1986; Froetschel and Martin 1990; Dove and Hayden 1992) and thus may affect the performance of biological treatment units for animal wastes. Summary of animal waste characteristics are presented in Table 4.

Table 3. Some Antibacterial Agents, Hormones and Special Purpose Feed Additives for Different Species Which are Under Control of the Food and Drug Administration*

Compound	Animal	Use Level**	Claims***	Withdrawal before Slaughter
Antibiotics				
Bacitracin	Feedlot cattle	35 mg./h./d	GP	
Chlorotetracyclin	Beef cattle	70-75 mg./hd./d	GP, FE, LA	48 hr.at 350 mg/hd./d
Chlorotetracyclin	Chicken, turkeys	10-500 g./T	GP, FE, RD	
Chlorotetracyclin	Swine	10-100 g./T	GP, FE, BE	
Antimicrobial agents				
Arsanilic acid	Chicken, turkeys	45-90 gl/T	GP, FE, EP, CC	
Monensin	Broilers, replacements	90-110 g./T	CC	
	Feedlot cattle	5-30 Q./T	GP	
Sulfamethazine	Swine	0.0025-0.0075 %	GP, FI	15 d
Hormone Production Improvers				
Thyroprotein	Dairy cows	0.1-1.5 g/100 lb BW	MP	
Thyroprotein	Growing ducks	100-200 g./T	GP	
Special Purpose Additives				
Amprolium	Calves	5 mp/kg BW for 21d	CC	24 h
Phenothiazine	Chicken, turkeys	0.2-0.6 % in feed	Cecal Worms	
Levamisole HCl	Swine	0.08 %	GW, lung worms	72 h

*Source: Church 1986.
** Quantities are given in grams (g) per ton (T) of feed or % in feed in most instances.
*** Abbreviations used: GP, growth promotion; FE, feed efficiency; LA, lactation; RD, respiratory disease; BE, bacterial enteritis;; EP, egg production; CC, coccidiosis, MP, milk production; GW, gastro intestinal worm control.

UPGRADING ANIMAL WASTE

Waste materials from the livestock industry can help fulfill the requirements for food, feed, fuel and fertilizer which I call the 4 Fs. Rising oil prices, foreign exchange, imbalances, and especially pollution and soil erosion, necessitate the utilization of animal industry wastes in different areas. When selecting their use one should consider :

a. Health: When animal wastes are used for human or animal consumption as fertilizer, the presence of toxicants, toxins and pathogens should be monitored and controlled to avoid hazards to man, animals or crops.

b. Quantity and quality of waste and then availabilities: Slaughterhouse wastes or manure, if available year-round, could justify establishment of algar or fish culture or productive fermentation process.

c. Technological and industrial resources and most importantly social change-for example, bias against food produces from wastes.

Table 4. Summary of Animal Waste Characteristics[a]

Parameter[b]	Dairy cow	Beef feeder	Swine feeder	Sheep feeder	Poultry		
					Layer	Broiler	Horse
Raw manure (RM)[c]	82	60	65	40	53	71	45
Total solids	10.4	6.9	6.0	10.0	13.4	17.1	9.4
Volatile solids	8.6	5.9	4.8	8.5	9.4	12.0	7.5
BOD	1.7	1.6	2.0	0.9	3.5	-	-
COD	9.1	6.6	5.7	11.8	12.0	-	-
Nitrogen (total, as N)	0.41	0.34	0.45	0.45	0.72	1.16	0.27
Phosphorus (as P)	0.073	0.11	0.15	0.066	0.28	0.26	0.046
Potassium (as K)	0.27	0.24	0.30	0.32	0.31	0.36	0.17

[a]J.R. Miner and R.S. Smith eds., "Livestock Waste Management with Pollution Control", North Central Regional Research Publication 222, MWPS-19. Midwest Plan Service, Iowa State University, Ames, 1975. In. Loehr (1977).

[b]Characteristics are in terms of weight of parameter per day per 1000 liveweight units (pounds or kilograms).

[c]Feces and urine with no bedding.

A. Converting Animal Waste to Food

Animal wastes and crop residues can all be converted to food by some form of bioconversion. Jordan (1988) emphasized the power of biotechnology indicating that we are entering into an era in which a new tool is being applied. That new tool is identified under the banner of biotechnology.

Chemical and physical treatments of animal wastes may not be suitable for direct food production because it may be difficult to monitor the safety for health. Higher fungi-mushrooms have been used as human food for centuries. Mushrooms can transform nutritionally valueless wastes (manure and crop resides) into highly acceptable nutritious, valuable food. Kurtzman (1979) indicated that Agaricus bisporus (common mushroom) and Agaricus bitorquis can be grown on composted horse manure or rice straw. After using for mushroom growing, the compost can be returned to the field as fertilizer. Pullin (1980) indicated that in Taiwan growing mushrooms on composted rice straw (animal manure, straw and wood waste mixture) has become a multi-million dollar business and gave them export opportunities. Under a controlled environment, mushroom shelters can be productive units yielding up to 120 kg/m^2 each season (Kurtzman and Ahmad, 1975).

If a large fraction of the wolrd's population continues to be malnourished and hungry, it will be a politically unstable world. Microbial conversion of wastes, including manure, offers the opportunity to convert a large fraction of their nutritional need into an effective demand by helping the undurnourished in the Third World to supply their own food and feed.

B. Feed From Animal Waste

Nutrients from waste are, either directly or after some processing, usually upgraded to human food via farm animals. The nutritional (and toxicological) evaluation of wastes as an animal feed is, therefore, the most relevant one. It was emphasized that biological testing of nutritional and toxicological characteristics are concerned with nutritional value for the animals, and safety of the animal products for human consumers (Wal Der Van, 1976; Smith and Wheeler, 1979).

Day (1980) has noted that on an annual basis a laying hen produces about twice as much crude protein as manure than in the form of eggs. Smith and wheeler (1979) have cocluded that economic value of extreta as a feed ingredient for some ruminants is 3-10 times greater than its value as fertilizer. Ensilage is effective in making animal wastes safe for refeeding (N.R.C. 1981). When properly treated, ensiled wastes undergo lactic acid fermentation, and if the product is held for 10 days in a silo prior to feeding, pathogenic bacteria such as Salmonella, parasidic nematodes, and coccidia are practically eliminated. Spore forming bacteria, while not destroyed, do not proliferate; these bacteria are usually not harmful. Moreover, ensiled animal wastes look and smell better than untreated excreta. In this system, a workable formula is 60 parts swine or cattle waste, 20 parts air dried poultry litter, and 20 parts ground grain, hay or crop residue. This type of formula is generally known as "wastlage" (N.R.C. 1981). Wastlage may constitute the entire ration for breeding cattle; enriched with higher energy feed, it can be fed to growing and lactating animals (Muller, 1980). In some commodities, the chemical nature of the waste material for example, the high ash content of chicken manure and high silica content of rice hulls and straw may be unsuitable (N.R.C. 1981). Ben-Ghedalia, et al (1982); Cooke and Fontenot (1990) showed that even though swine waste and broiler litter are high in ash, sheep and steers absorb P from poultry manure effectively.

Recycling some animal wastes may be a result of the concentration of pesticides or of medicines used to promote animal growth or to control animal diseases (Table 3). N.R.C. (1981) stated that some wastes may contain undesirable amounts of heavy metals such as mercury, cadmium or lead or toxic organic compounds such as chlorinated biphenyls. It should be recognized here that there is a wide area to be discovered, relating to improving safety, acceptability and processing methods. In spite of those indicated above, very positive responses were obtained with animal feeding trials; (Berger, et al 1981) with pigs; (Martin 1980) with laying hens. Seal and Eggins (1976) upgraded the nutritive value of pig manure by using thermophilic fungi. This product has been fed to rabbits with no gross toxic effects. I should point out here that the greatest problem facing the produced in any new upgrading development of manure feeding (recycling) ise to gain the confedence of the consumer. However, in spite of these constraints, there will be a general trend towards utilization of manure or litter as animal feed either directly or after some form of processing treatment.

The controlled discharge of animal and human wastes may cause environmental pollution and threaten public health. Research in different countries have shown that algae is one of the cheapest ways to treat animal waste waters which is excellent substrate. Algae, the microscopic planktonic plants, are capable of photosynthesis in the presence of sunlight and release of oxygen. The oxygen supports bacterial population that breaks down the organic matter in wastewater. This symbiotic action renders the organic matter in nocuous and at the same time converts the waste into nutrients for algae (Muller 1980; N.R.C. 1981). The water then has a much reduced organic matter with biochemical oxygen demand (BOD) ranging from 30 to 80 mg/L and can be discharged with minimal environmental impact. The algae containing 45-65 % crude protein can be harvested and processed for animal feed (Majid and Akhtar 1980; Muller 1980; N.R.C. 1981). Although algae production from human and animal waste seems promising, the technology is not fully developed. The main concern is the possible contamination of manures by pathogens, antibodies, pesticides, hormones or other chemicals.

Modern farming methods applied in the U.S.A. to produce channel catfish use commercial feed and incur high labor and equipment costs. Annual yields average 2.000 kg/ha. (N.R.C. 1981). However, mixed species of carp are grown in Taiwan, India, Malaysia and Indonesia using animal manures and other farm wastes as feed. Annual yields range from 5.000 to 8.000 kg/ha. (Djajadiredja and Jangkaru 1979; Edwards 1980). An outstanding example of the benefits of polyculture on fish yields found in Israel and in Illinois. Buck, et al (1978) fed channel catfish commercial high protein pellets, the maximum production was about 1.500 kg/ha. When the same ponds were manured and stocked with a polyculture of Chinese carp, the net gain was increased to 4585 kg/ha. In Israel, it is considered safe to use 75-100 kg/ha. 1 day (dry organic matter) of manure (N.R.C. 1981).

Fish may carry human pathogenes in or on their bodies, and these pathogens may subsequently infect those who handle, prepare or eat the fish. Cooking would eliminate this danger. Another health hazard associated with fish farming is the transmission of parasitic worms to man through an intermediate fish host. Clonichis sinensis and O. felineus are parasitic flat worms that cause liver infection in man (Muller 1980; N.R.C. 1981). It should be noted here that for any food or feed materials, proper handling of the raw material and products is needed to assure animal and human safety. The feasibility of waste to feed projects depends on the characteristics, availability and cost of collection and transport of the raw material and the availability of a market for the end product.

C. Fuels From Animal Waste

Developing countries mainly depend on wood, crop residues, animal dung and coal besides animal and human power for their basic energy needs. This energy is essentially used for production, processing and preparation of food. Fuel wood supplies are dependent on a supporting ecosystem that is being disrupted in many areas by population growth. Where wood resources are extremely overused withoud replanting, serious soil erosion has resulted. As a consequence of fuel wood shortage, dung is increasingly being used as fuel instead of being returned to soil as fertilizer. This type of chain reaction not only destroys the environment but opens the doors for further damage of the surroundings of human beings. N.R.C. (1981) indicated that 20 % of India's energy needs are supplied by burning cow dung. The search for fuel by women and children, who must devote a large portion of their time to gathering fuel, is at the expense of schooling and other constructive activities. The two general approaches available for the conversion of wastes to fel are biological and thermochemical (Loehr 1974; Muller 1980; N.R.C. 1981).

Methane generation is fully explained (Loehr, 1977). In this process, waste mixed with water, called slurry, is fed to an enclosed digester. In the digester, the gas (60-80 % methane) is trapped by an inverted drum covering the surface of the liquid. As gas is produced, the drum rises acting as a gas storage chamber. The gas can than be drawn off for use as needed. This process yields a number of benefits:

a. Produces an energy source that can be stored and used more efficiently.

b. Creates a stabilized residue that retains the fertilizer value of the original material.

c. Reduces fecal pathogens (Enteric viruses, Salmonella, Shigellae, E. Coli, Cholera, Hookworm ova, etc. World Bank 1980) and improves public health.

d. Reduces trasfer of plant pathogens from one year's crop residue to the next year's crop.

For any of the waste-to-fuel processes, availability of capital is always a limitation (N.R.C. 1981), especially for developing countries. However, centrally produced components could be an advantage. Different systems capable of handling different wastes form agro-industrial processing plant are discussed by different scientists (Barnett, et al 1978; Middlebrooks, 1979; N.R.C. 1987). However, adopting of biogas technology and integrated farming systems requires farmers to make changes in their traditional social patterns and farming practices (Augustburger, 1988).

D. Fertilizer From Animal Waste

During the history of human beings, almost all nutrients and organic wastes were returned to the soil. N.R.C. (1981) claims that recent human activities have altered this cycle and organic wastes have been diverted into waterways.

Crop production and erosion strip organic matter and mineral nutrients from the soil. Since the introduction of chemical fertilizers, many farmers have been able to ignore the importance of maintaining soil fertility by the restoration of organic materials. However, farmers in Asia, many whom have limited access to chemical fertilizers, have not forgotten that is vital to husband their fields as their ancestors did for generations. Although organic wastes are directly applied to the land without retreament in many contries, the presence of potentially dangerous organisms in human and agriculture wastes has led to the development of a variety of treatments (composting) that reduce this problem and yield products more beneficial to the soil; for example as a good nitrogen source (Table 4); (NAS, 1977; N.R.C. 1981). In the process, other agricultural cellulosic waste materials (corncobs, wood shavings and sawdust, etc.) are also utilized (Loehr, 1977). Fly control and destruction of disease vectors occurs in the process. On-site composting of poultry manure within the poultry house (Howes 1966) resulted in an odorless, fly-free environment and was relatively inexpensive.

Whatever the form of nitrogen applied, it is normally quickly converted to the nitrate form by biological process. Nitrate is highly soluble rendering it highly mobile so that it moves with the soil water (Gardner and Watson 1986). Schilfgaarde (1986) indicated that in Iowa in the Big Spring Basin there is a close direct relation between the increase in fertilizer-N-use and the NO_3-N recorded in the ground water since 1958. As Chemical fertilizer use goes up and the amount of manure used goes down, NO_3 in the drain water also goes up (EPA's maximum nitrate (as N) contaminant level is 10 ppm.

Management of dairy and feedlot waste requires management of the hydrological cycle since it is those components of the waste which are soluble in water which represent a hazard to ground and surface water. Some researchers have reported unacceptably high concentrations on nitrates in ground water samples near feedlots no longer in use (Gardner and Watson 1986). The diversion of non-polluted surface runoff and building roof runoff away from feedlots (and other livestock operations) and the use of vegetative filter strips to treat runoffs have been found to be effective practices for surface water protection. In addition to best management practices:

1. Proper lagoon construction,
2. Containment of runoff,
3. Manure nutrient analysis (including pollutants),
4. Analysis of the samples from environment under which the waste exists.

6. PUBLIC HEALTH, HEALTH IMPLICATIONS AND SOCIO-ECONOMIC PRESSURE

When human and animal excreta is used directly or indirectly for the production of food, feed or fertilizer, it is essential to consider health implications. As it was briefly discussed throughout this paper, unsanitary practices can result in the spread of disseases or in debilitation caused by toxic substances. Waste utilization, therefore, must be carefully monitored for adverse effects.

The contamination of vegetables irrigated with those is likely to cause epidemics of infectious diseases in several instances. It is also possible that some individuals can be heavily infected with hookworm and suffer more intestinal infections than others in the same community. Fish and crustacea in aquaculture projects using domestic wastewaters can be contaminated. Hepatitis is a particular hazard. Scistosomiasis propagation through infected waste and urine is also a particular concern in some areas of the world.

With increased discharge of agricultural and industrial wastes into sewage systems, levels of heavy metals and toxic substances are increasing. Because fish and other elements of the human food chain can concentrate such substances in their tissues, consuming them can result in human illness. These public health concerns can be overcome by proper management by hygienic methods.

Studies (Muller, 1975, 1980; Westings, et al, 1978) indicated that the content of mineral elements in liver tissue as a result of waste feedings changed quite considerably in some instances, but most of the minerals studied were within their tolerance levels of cattle. Levels of arsenic accmulated in the animal tissue were always much below the permissible level and were markedly reduced by a withdrawal period five days prior to slaughter (Caswell, et al, 1978).

A large number of pesticides are used in farms and agro-related industries. A comprehensive study of the fate of residual pesticides in broiler litter was carried out by Fontenot, et al (1971); the data indicates that the level of pesticides is often higher in cattle fed conventional feed ingredients than in cattle fed poultry litter or other animal wastes. This is because the use of pesticides in agriculture is widespread and high levels may often occur in forage feed and crop residues.

Salmonella is probably the most widely recognized threat; potentially pathogenic microorganisms which easily may occur in animal waste (Van der Wall 1983) or pathogenic strain may follow the route waste, feed, animal, man. On the other hand, the feeding value of animal wastes can seriously be affected by mycotoxins ('Aspergitlus and Pencillium) (Muller 1975). Drying and other processing (Ensiling) of waste stops those microbial growth.

Nitrate levels in water supplies may be influenced not only by manuring and particularly fertilizing, but also influenced by the highly populated livestock production farm areas which pollutes drinking water and casually connected with methahemoglobin formation and consequently cyanosis. It even may be carsinogenic (Jollans 1983). It should be indicated here that Kansas was one of the first states in the U.S. which adopted the regulations for the control of water pollution from animal feedlot operations (Ledward, et al 1983).

Besides these concerns, there are many unanswered questions with regard to animal wastes as agents of disease transmission, and information on basic research is still lacking.

Nutritional and health implications of food from animal waste-fed animals are often recognized at a rather late stage of its development. This is due to the fact that initially only analytical characteristics and physical process parameters are measured. These factors provide only a limited possibility for predicting nutritional and health aspects of the product under development. Biological tests with rats produce more indicative data (Van der Wall 1983). Safety problems may have to be faced in terms of potential transfer of toxic substances from waste to the products. For instance, as Shacklady (1979) indicated in the case of mushroom production, it is obvious that a guarantee of nutritional and toxicological adequacy, however, may not convince public health authorities that extrapolation and upscaling of these processes is justified without a more systematic analysis of the health hazards.

Undoubtedly, public pressure to abate pollution is justified. Although not all the environmental damage we see from pollution comes from organic wastes (manure), a substantial part of it does. Plaskett (1976) indicated that currently one can discern some intellectual confusion between waste disposal on one hand and waste utilization on the other. In practice, only rarely will the optimum method for low-cost disposal coincide with an optimum use of the material concerned. Disposal produces no economic benefit apart from avoidance of environmental damage and is always a cost upon the producer of the waste. Utilization normally demands more investment but produces economic benefits related to the present and future value of the recorvered material. Avoidance of the disposal cost is always a factor in calculating the benefits of a utilization process. Public pressure against pollution is hence a real and justified factor in promoting utilization of organic wastes (manure).

CONCLUDING THOUGHTS

The environment-agricultural production relation and continued concern over food and feed safety will be the primary regulatory emphasis of the U.S. Department of Agriculture, the EPA and OSHA in the Late 1990's.

Actually, we know little bout the accumulation and flow-through of many of the animal waste components concerned. Scientists with field experience know that each stuation on each case will differ comewhat. Some animal production units will have no outflow but evaporation; some flow-through. So we face a three dimensional matrix of different conditions.

At present, most animal wastes are disposed of land either directly from the animal or by spreading and do not represent a direct water pollution source. Even from beef cattle fedlots it is estimated that less than 5-10 % of the wastes may reach a stream when runoff is large.

The environmental issues are fueling a very emotional debate. EPA's storm water runoff regulation will probably become final pretty soon (Emnett 1989). Besides federal government regulations, in Kansas, developers of feedlots and other facilities with the potential to pollute ground water force tighter restrictions over legislation proposed in the fiscal 1994 Kansas Water Plan (Denning 1992). This regulation requires that manufacturers (producers) have a permit to allow rain water to run off the property. To get the permit, facilities will hava to prove that no hazardous chemicals or high organic matter are running off the property with storm water runoff and into waterways.

There is a benefit that we have all utilized from our use of manure and chemicals toward the end of the century. However, we have to start to get ready to remove those chemicals from our food, feed, fertilizer and most importantly from our environment which are the most harmful. As in the case of nutritional evaluation, two options are open for assuring acceptable safety aspects: analytical and biological testings which must be investigated thoroughly.

Most of the residues, chemicals and pesticides in livestock waste feeding apparently represent no serious threat to humans, and different processing methods of animal wastes eliminate the danger of the pathogenic microorganisms.

Finally, many agricultural operations will give use to extensive sources of contaminant production where escape of the contaminant can not be prevented. Certainly, the need for cooperative action between dhe different disciplines of livestock industry and farm operations toward reducing the pollution coming from animal waste is necessary.

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