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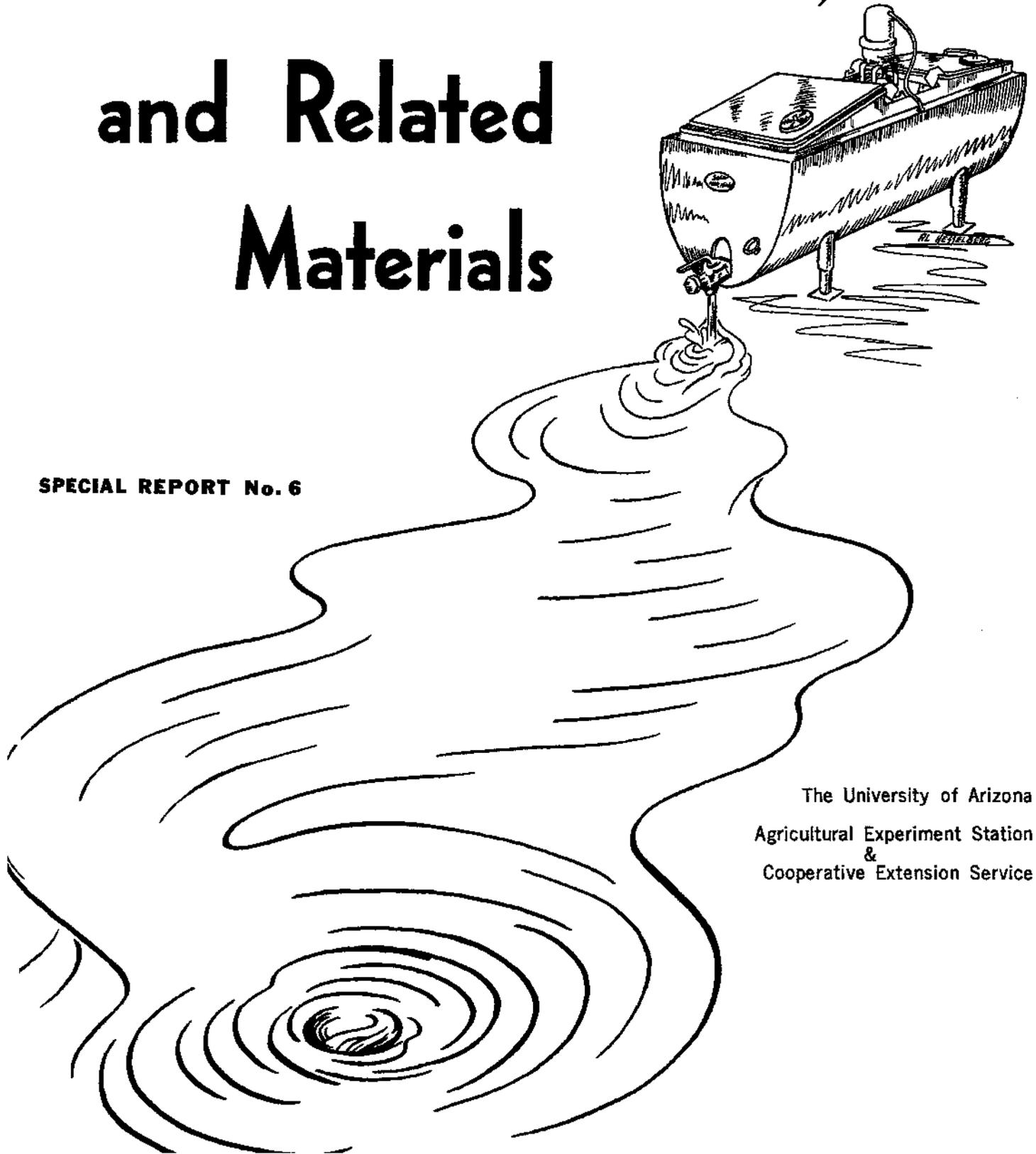
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# Keep Milk Free of Pesticides, Antibiotics, and Related Materials

**SPECIAL REPORT No. 6**



The University of Arizona  
Agricultural Experiment Station  
&  
Cooperative Extension Service

THE DAIRYMEN, FEED PRODUCERS, PROCESSORS AND PUBLIC HEALTH  
AUTHORITIES ARE WORKING TOGETHER TO KEEP THE MILK FREE OF PESTI-  
CIDES, ANTIBIOTICS AND RELATED MATERIALS.

REMEMBER: ALL CHEMICALS ARE DANGEROUS IF USED IMPROPERLY!  
ALWAYS READ THE LABEL -- FOLLOW DIRECTIONS CAREFULLY -- USE ONLY  
AS SPECIFIED -- OBSERVE PROPER SAFETY PRECAUTIONS. KEEP ARIZONA'S  
FOOD AND FEED CROPS FREE OF CONTAMINATION.

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KEEP MILK FREE OF --- Pesticides, Antibiotics, and Related Materials

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KEEP MILK FREE OF --- Pesticides, Antibiotics, and Related Materials

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SPECIAL REPORT NO. 6

REGULATIONS PERTAINING TO MILK CONTAMINATION

The United States Public Health Milk Ordinance and Code adopted by the Arizona Legislature states that, "the presence of antibiotics, chemical bactericides, or other unapproved additives shall be deemed a violation--". Milk is defined in the ordinance as, "the lacteal secretion---obtained--- (from) one or more healthy cows, ---". Finally, "any adulterated, misbranded, and/or improperly labeled milk or milk products may be impounded by the health officer and disposed of in accordance with State Law".

The Federal Food and Drug Administration (F.D.A.) has regulatory jurisdiction over foods shipped from one state to another. F.D.A. officials and the Commissioner of Public Health in the Arizona State Department of Health have taken a firm, rigid stand on the enforcement of these provisions as they apply to the presence of antibiotics, pesticides and related materials in milk and milk products. Milk products containing these materials are subject to seizure and can be taken off of the market.

SOME RECOMMENDATIONS TO FOLLOW FOR THE USE OF PESTICIDES AND RELATED MATERIALS

The following recommendations will enable you as a dairyman to control contamination of your milk with pesticides and related materials:

1. If it is necessary to use pesticides and related materials, be sure that they are used for the purpose that they are recommended. Also be sure to follow the instructions on the label of the manufacturer for their use.
2. Buy your alfalfa hay during the spring months. Indications are that alfalfa hay produced through May is less likely to be contaminated with pesticides. In buying hay, be sure that it does not contain detectable pesticide residues. Your dealer may offer a guarantee, such as it is, in regard to the maximum pesticide residue content, subject to your test.
3. Do not use any by-product feeds. These may be feeds such as cull vegetables, bermuda seed straw, alfalfa seed straw, and many other products whose use as feeds are secondary to the primary crop. Most of the crops that provide by-product feeds have been treated according to recommendations for their specific tolerance levels, but do not take into consideration that they may be used for dairy feed.
4. Do not use cotton gin trash or other potentially contaminated by-products for bedding of any cow or heifer which eventually will be included in the milking herd for the production of milk.
5. If you are growing or purchasing a feed crop (such as alfalfa hay or hegari) that is grown next to a crop which has been treated with pesticides, be sure that your crop has not been contaminated by drift of materials in an amount that will cause you to have contaminated milk.
6. Use caution in buying cows and springer heifers. If they have been fed contaminated feeds, they could cause a problem when they freshen and their milk is added to the total herd milk.

## REASONS FOR CONCERN ABOUT INSECTICIDES AND OTHER PESTICIDE RESIDUES

The concern over chronic toxicity by the Food and Drug Administration has led them to limit the amount of pesticide chemicals that can be legally present on or in food to a level sufficiently low that there can be no doubt that it is safe.

"Chronic toxicity" is a possible hazard from consuming small amounts of pesticides over a period of several years, which may affect the health of an individual.

The level may vary for different kinds of food for the same pesticide. The Food and Drug Administration has set up the level of ZERO for all pesticides in milk!! ZERO or "analytical zero" is less than 2.5 parts per million in butterfat. This is equivalent to 0.088 parts per million in the milk.

Milk occupies a special place in the diet of the public. For this reason efforts should be taken to assure that milk continues to occupy a position of being a wholesome, nutritious and pure food.

Pesticides, herbicides, and other materials get into milk by careless or improper use of feeds, animals or equipment. Many insecticides cannot be used at all on feeds or by-product feeds going to dairy animals. Some materials can be used within certain limitations. Follow the University of Arizona, Federal, or manufacturer's recommendations concerning their application.

## HOW INSECTICIDES AND OTHER PESTICIDE RESIDUES MAY GET INTO MILK, AND RECOMMENDATIONS

Pesticides can get into milk from feed and water supplies, skin penetration or direct contamination by the following methods:

(1) Contamination of Milk Handling Equipment, Feed and Water, or Animals during treatment of the barn for fly control: Many insecticides can be used to treat the interior of milking barns, rooms or corrals, and shades for fly control which cannot be used on the animals or animal feed. It is essential to remove animals, feed and water, and to cover milk handling equipment so that none of these will become accidentally contaminated with any pesticide while treating the barn.

Insecticides which may be used to treat dairy barns and premises:

<u>Insecticide</u>	<u>Application</u>	<u>Tolerance in milk (ppm*)</u>
Diazinon	Residual <u>spray</u> , dry or <u>wet bait</u> and treated <u>bait cord</u>	Zero
Dibrom	Treated <u>bait cord</u>	Zero
Dimethoate	Residual <u>spray</u>	Zero
Dylox	Residual <u>spray</u> , dry or <u>wet bait</u> and treated <u>bait cord</u>	Zero
Malathion	Residual <u>spray</u> , dry or <u>wet bait</u> and treated <u>bait cord</u>	Zero
Methoxychlor	Residual <u>spray</u> , dry or <u>wet bait</u> and treated <u>bait cord</u>	Zero
Pyrethrum	Mist or fog spray	Zero

\* ppm - parts per million

(2) Improper treatment of animals for control of flies, lice, ticks or grubs: The insecticides which can be used to treat milking animals directly are very limited in number--they include only rotenone, pyrethrum, methoxychlor, and malathion. If other insecticides are used accidentally or intentionally, the treated animal must be pulled out of the milking herd for from 4 days to 8 weeks or more, depending on the insecticide used.

Insecticides which may be used directly on producing dairy cows:

<u>Insecticide</u>	<u>Application</u>	<u>Tolerance in Milk (ppm*)</u>
Malathion	Applied as a <u>5% dust</u> not less than 5 hours before milking	Zero
Methoxychlor	Applied <u>only as a dust</u> not more often than every 21 days	Zero
Pyrethrum	Applied at any time as a <u>dust</u> or <u>spray</u>	Zero
Rotenone	Applied at any time as a <u>dust</u> or <u>spray</u>	Zero

\*ppm - parts per million

(3) Improper treatment for pests of forage or grain crops to be used for feed: Some farmers may treat their forage and grain with insecticides which are not recommended. Long after a crop, such as alfalfa, has been treated for insect control, minute amounts of the insecticide may remain at the time the crop is harvested and fed to a producing cow. Some insecticides will be destroyed by the cow, but others will be concentrated many-fold in the milk. The long residual life on or in the plant material, and the resulting concentration in the body fat and milk is why many insecticides are prohibited from use on dairy cattle feed. The DDT-like insecticides (chlorinated hydrocarbons) present the major problem. The amount of these materials allowed in milk under present regulations is ZERO.

Insecticides and Herbicides which may be used on Feed Crops for Dairy Cows:

<u>Insecticides</u>	<u>Days After Treatment-to Harvest</u>	<u>Tolerance on Feed (ppm)*</u>	<u>Tolerance in Milk (ppm)*</u>
Demeton (Systox)	21	5 ppm-fresh cut hay) 12 ppm-baled hay )	Zero
Diazinon	7	3 ppm-fresh cut hay) 10 ppm-baled hay )	Zero
Dibrom	4	Zero	Zero
Dylox	14	Zero	Zero
Malathion	7	8	Zero
Methoxychlor	7	100	Zero
Methyl Parathion	20	Zero	Zero
Parathion	15	1	Zero
Phosdrin	1	1	Zero
Sevin		100	Zero
<u>Herbicides</u>			
DNAP-phenol	(Dormant or stubble)	Zero	Zero
	( )		
DNBP-phenol	(treatment only for)	Zero	Zero
	( )		
DNBP-ammonium salt	(all herbicides )	Zero	Zero
Diuron		2	Zero

\*ppm - parts per million

The tolerance of insecticides on feed as shown in the preceding recommendations is based on two types of limitations. The first is on the disappearance of the insecticide on the crop before harvest, and second, is the tolerance based on the "feed-thru factor", which is the amount of pesticide that can be present in or on the feed with none of it appearing in the milk.

(4) Contamination of forage or grain crops from drift in the treatment for pests or insects on adjacent crops: When alfalfa, silage or grain is grown next to another crop, such as cotton or vegetables, which may require intensive use of insecticides in its production, the insecticide can possibly drift on to the feed crop. This feed may show sufficient contamination that when it is fed to dairy cows, it will show up in the milk.

The safe downwind distance for the drift of a pesticide is variable, depending on the velocity of the wind, methods of application and other factors. The hazard of contamination from downwind drift can vary from no measurable amount to a measurable amount as far as 2 miles. A good dairyman will attempt to make sure that his feed is free from detectable contamination, and whenever there is a possibility of contamination on feed, be sure to have a test made. At the present time detectable contamination in the milk from different levels of pesticide residue for all insecticides has not been determined. However, there is research completed to show that 0.5 parts per million of DDT or 2.5 parts per million of Toxaphene on or in the feed will not show up in the butter fat at the 2.5 parts per million level. This level of contamination in the feed has not been established as a tolerance level in Arizona or by the Federal Food and Drug Administration.

The above is the best information at the present time. However, conditions are changing so rapidly that this may not be true within the next few months.

Insecticides and Herbicides which may be used on adjacent crops and cannot be used on feed crops: You should be able to recognize the different types and origin of materials which may be involved in the contamination of milk. These may be classed and described as follows:

A. Insecticides which may be used on non-feed and forage crops in Arizona

- |              |                |                      |
|--------------|----------------|----------------------|
| 1. Aldrin    | 7. Dilan       | 13. Phorate (Thimet) |
| 2. Aramite   | 8. Di-Syston   | 14. Tedion           |
| 3. BHC       | 9. Endrin      | 15. Thiodan          |
| 4. Chlordane | 10. Heptachlor | 16. Toxaphene        |
| 5. DDT       | 11. Kelthane   | 17. Trithion         |
| 6. Dieldrin  | 12. Lindane    |                      |

B. Herbicides which may be used on non-feed and forage crops in Arizona:

4-(2,4-DB)	DNBP-amine salt
Endothal	PCP
Dalapon	

(5) Use of contaminated by-product feeds: An important source of entry of insecticide into the milk may be the use of by-product feeds that were treated in accordance with tolerance regulations for production of the primary crop, but which did not take into account that a possible secondary use of remaining plant parts would be for dairy feed (for example, cull vegetables, bermuda straw, alfalfa seed straw, etc.). This often places more rigid restrictions on the insecticides which can be used. There are so few fresh by-product feeds that can safely be fed to dairy animals that it is best to forget them. Do not use cotton gin trash or other potentially contaminated by-products for bedding of any cow or heifer which eventually will be included in the milking herd for the production of milk.

Insecticides and pesticides which may be used on crops that provide by-product feeds and cannot be used on feed crops. The following insecticides, and others, are used for control of insects attacking alfalfa being grown for seed. The straw and remains after threshing must never be fed to dairy animals. These materials cannot be used on alfalfa being grown for feed for dairy animals or animals for slaughter:

DDT	Kelthane
Dieldrin	Toxaphene

There are many insecticides that are used on a variety of crops producing by-product feeds which cannot be used on dairy feed. If these have been used, neither the crop nor the by-product feed from it can be fed dairy cattle. The following list of insecticides in this category is not complete, but is merely illustrative of the more common ones which cannot be used on feed crops:

Aldrin	Dieldrin	Lindane
Aramite	Dilan	Phorate (thimet)
BHC	Endrin	Tedion
Chlordane	Heptachlor	Thiodan
DDT	Kelthane	Toxaphene
		Trithion

(6) Another Possible Reason for Sudden Detectable Levels of Pesticide Residue in Milk: There is evidence that dry cows and heifers fed contaminated feeds will show higher concentration of pesticide in the milk during the first two to four months after freshening than later on in their lactation. This is because the pesticide residues we are concerned with tend to be stored in the body fat. In "milking off" this body fat, these stored residues find their way into the milk of the cow or heifer.

If several cows freshen at about the same time or if even one cow is throwing off a high amount of pesticide, it could raise the entire herd milk to detectable levels.

How long it will take the cow's milk to drop below detectable levels depends on: (a) the length of time she was fed contaminated feed and (b) the level of residue on the feed fed. It could take up to 120 days on "clean feed" for such cow's milk to reach ZERO.

If a sudden detectable level of residue is found in the herd milk that cannot be explained by known treatment of the animal, premises, or feed, it would be well to pull the fresh cows out of the milking string until their milk can be tested to determine if they are the source of the problem.

This storage of pesticides in the body fat of heifers and cows is the basis for recommending caution when adding new heifers or purchased cows to the herd.

#### SUMMARY OF INSECTICIDES APPROVED FOR USE ON OR NEAR DAIRY CATTLE AND FEED

##### In the Barn

- |                     |                 |
|---------------------|-----------------|
| 1. Diazinon         | 4. Malathion    |
| 2. Dibrom-bait cord | 5. Methoxychlor |
| 3. Dylox            | 6. Pyrethrum    |

##### On the Animal

- |                 |              |
|-----------------|--------------|
| 1. Malathion    | 3. Pyrethrum |
| 2. Methoxychlor | 4. Rotenone  |

##### On the Feed

- |                     |                     |
|---------------------|---------------------|
| 1. Demeton (Systox) | 6. Methoxychlor     |
| 2. Diazinon         | 7. Methyl Parathion |
| 3. Dibrom           | 8. Parathion        |
| 4. Dylox            | 9. Phosdrin         |
| 5. Malathion        | 10. Sevin           |

Do not use in, on, or near dairy cows, dairy feed, dairy barns, or milk rooms any insecticide or other pesticide that has not been recommended specifically for such use.

#### PROCEDURE USED IN DETECTION OF PESTICIDES IN MILK

The tolerance for all pesticides in milk is ZERO. ZERO is an amount of pesticide smaller than the least amount which can be detected. Thus ZERO, or more properly "analytical zero", changes as the methods of analysis change.

The use of the figure "less than 2.5 parts per million in the butterfat" refers to "analytical zero". This is true for the analysis of DDT by the specific colorimetric method (Schechter-Haller Method), because the least amount of DDT that one can detect is 2.5 millionths of a gram in each gram of butterfat. One gram is 0.035 of an ounce. This is equivalent to 0.088 parts per million of DDT in whole milk. The reason for the emphasis given these figures is that DDT is the most common insecticide found in milk and the Schechter-Haller Method is the detection method of choice in the enforcement procedures.

Other methods of detection exist - the most notable of which is a paper chromatographic method known as "Mitchell-Mills Method". This method will detect almost all chlorinated hydrocarbon insecticides (DDT, BHC, Aldrin, Dieldrin, Toxaphene, etc.) at the same time. It is not as specific as the colorimetric method, as one insecticide can be mistaken for another, nor is it as accurate as the specific colorimetric method because the quantitative estimation is made by visual comparison with known standards. The Mitchell-Mills Method is very sensitive, since one-ten millionth of a gram of insecticide can be detected in a gram of butterfat. Data are often tabulated as being "above or below zero". In this case the ZERO refers to the "analytical zero" of the Schechter-Haller enforcement method.

The Schechter-Haller and the Mitchell-Mills analytical tests for insecticides require specialized laboratory facilities, expensive and specialized equipment, and highly trained personnel. The tests for pesticides and related materials are more involved, tedious and exacting than other tests commonly run on milk, such as antibiotics, bacteria count, butterfat, etc.

The time required to complete a test on a set of samples is at least two days. However, the laboratory may not be able to get the results on a set of samples completed in this time as it is necessary for the laboratory to schedule the test into its operation. They may have a back-log of samples in the process of testing, and these must be completed before a new set of samples can be started through the testing procedure. Therefore, the time required to complete a test is from two to seven days in order to get complete results.

Because of the time, equipment and skills required, the cost of testing for pesticide residues in milk, other dairy products and feed, is considerably higher than the cost of other tests commonly made on these products.

In the United States there are only a few laboratories that are qualified to turn out accurate results. This is due to the fact that the tests now used to determine the amount of pesticides or insecticides in any given sample are so specialized and difficult.

PART II: ANTIBIOTICS AND RELATED MATERIALS

SOME RECOMMENDATIONS TO FOLLOW FOR THE USE OF ANTIBIOTICS AND RELATED MATERIALS

The following recommendations will enable you as a dairyman to control contamination of your milk with antibiotics and related materials:

(1) Good management practices will enable you to keep at a minimum mastitis and other diseases that require treatment from antibiotics and other drugs. This will reduce the amount of antibiotics and other drugs to be used in the treatment of dairy cattle.

(2) If it is necessary to use antibiotics and other drugs be sure that they are used for the purpose for which they are recommended. Also be sure to follow the instructions for their use placed on the label by the manufacturer.

(3) If dairy cows in milk are treated with antibiotics be sure to withhold milk that they produce from the market until there is no danger of the milk being contaminated. This will take 72 hours or longer, depending on the method used in the treatment of the dairy cow.

REASON FOR CONCERN ABOUT ANTIBIOTICS AND OTHER DRUGS

Why is there concern about the effects of small amounts of antibiotics and other drugs in foods such as milk? In the case of all except antibiotics the concern is based primarily on the possible toxicity of the materials for human beings.

The reasons for interest in the presence of minute quantities of antibiotics in milk are of two categories. First, there are possible public health hazards associated with the consumption of antibiotic-contaminated milk and milk products. These include the possibility of (a) causing or aggravating allergic responses; (b) changes in intestinal function; (c) development of antibiotic-resistant disease producing bacteria.

Second, in dairy plant operation antibiotics cause financial loss in contaminated milk due to (a) failure of bacterial starter cultures to grow normally when propagated; (b) reduction in acid and flavor production in cultured buttermilk and similar products; (c) failure of normal curdling of milk for all cheese varieties and abnormal ripening of cheese; and (d) inability of some quality control tests to give valid results. Extremely minute amounts of antibiotics may cause some of the difficulties mentioned. For example, milk from one quarter of a treated udder can contaminate (in detectable amounts) the combined milking from more than 100 cows for up to 72 hours, or longer, after treatment.

The antibiotic most commonly mentioned as being of concern is penicillin. It should be kept in mind, however, that any, or all, of the ones listed (or any new ones developed in the future) can cause difficulty.

#### HOW ANTIBIOTICS AND OTHER DRUGS MAY GET INTO MILK

Barring accidental contamination, antibiotics and other drugs get into the milk when the cow is treated for disease by the following methods: (1) udder infusion, (2) intravenous (into the vein) injection, (3) intramuscular (into the muscle) injection, (4) oral (drench or bolus) administration, (5) intrauterine (uterus) infusion, and (6) open wound or skin dressing or treatment.

In the treatment of an infection, such as mastitis, the healing value of the antibiotic or other drug is based on the development and maintenance of a certain required concentration of the drug at the site of the infection. It is, therefore, impossible to treat a milking animal by any of the methods without the possibility of some milk contamination. The type of infection should determine the method of treatment.

#### FACTORS WHICH AFFECT THE AMOUNT AND DURATION OF CONTAMINATION

The most important factors which affect the amount and/or duration of milk contamination from a treated animal are:

(1) Method of treatment. Udder infusion with antibiotics gives the greatest contamination for a relatively short duration.

While directions for use commonly recommend that milk from an animal treated by infusion cannot be saved for 72 hours, some technicians have detected antibiotics for 120 hours or more after infusion.

Each quarter of the udder is a separate, isolated gland. It might seem, therefore, that in the case of infusion treatment of only one quarter the milk from the other three could be saved for human use. This is not the case. Material infused into one diseased quarter may be absorbed into the blood stream and then appear in small amounts in the milk of the other three quarters. It is advisable to discard all milk from a treated animal for the recommended length of time.

One of the most direct sources of contamination has been traced to materials applied as an ointment or balm which find their way from the outside of the udder and teats to the teat cup surfaces and then into the milk.

Treatment by intravenous, intramuscular, or infusion in the uterus, will also result in contamination of the milk from animals so treated. In addition, the treatment of animals by drench or bolus, or the feeding of feeds containing antibiotics in large amounts, may result in the contamination of milk.

(2) Size or concentration in the dosage. The greater size or concentration of dose will cause greater contamination.

(3) Level of milk production. The amount of contamination per unit of milk is greater for lower producing animals.

(4) The size of the animals. For equal dosages, at places other than the udder, the larger animals normally would be expected to throw off relatively less material in the milk.

(5) The type of solution or carrier used with the antibiotic. Water solutions pass into the milk more quickly than do other preparations. Oil emulsions given intramuscularly are released into the blood and milk over a longer period of time. Many other types of carriers may be used. Each has its own characteristic release rate for the antibiotic.

(6) The type of antibiotic. Some antibiotics or other drugs may pass from the blood into the milk more quickly than others.

(7) The chemical form of any given antibiotic. Penicillin, for example, may be supplied in several different chemical forms, which will affect the amount and length of time milk will continue to be contaminated.

The question is sometimes asked about the method of treatment or application least likely to contaminate milk. In this regard the possible methods of each has its own characteristic rate of appearance in the milk. It can be seen, therefore, there are many factors affecting the extent and duration of milk contamination in treated animals. Follow the directions on the label or follow the advice of your veterinarian.

#### PROCEDURES USED TO DETECT ANTIBIOTICS IN MILK

Antibiotics and related materials are detected by various methods. Health regulation and enforcement is based on "ZERO tolerance". This term may be defined as something less than the smallest amount that a particular test can detect. On this basis, it should be recognized that the absolute amount for "ZERO tolerance" will probably change to smaller and smaller amounts as methods of detection become more and more accurate. This accounts, in part, for the seriousness of the problem, as more sensitive tests are likely to be developed.

At present, detection of antibiotics is based mainly on a biological test the disc assay method. In the method, Agar plates are inoculated with a culture of antibiotic-sensitive bacteria grown under standardized, controlled conditions. Then an absorbent disc of paper soaked with the suspected milk is placed on the culture. If antibiotics are present they prevent (inhibit) the growth of the bacteria around the edges of the disc. A specific neutralizing material (penicillinase) used along with the test will confirm the presence of penicillin. Other specific antibiotics are identified only by extremely complicated modifications of this procedure. Unless the more complex procedure is used, a positive test then will show only as penicillin or simply as an antibiotic or related mixtures or materials.

The biological test will not detect the presence of other drugs, pesticides, herbicides, detergents and sterilizing compounds except at exceedingly high and unlikely concentrations. Chemical analyses or other methods are used to detect the presence of these materials.

Milk suspected of containing any of the materials discussed here should not be included in the product intended for human consumption until there is certainty that it is entirely free from those materials.

## DETERGENTS AND STERILIZING COMPOUNDS

The likelihood of significant contamination with detergents and sterilizing compounds is extremely remote if directions for their use are followed. It is not a sound practice to cut down on the use of these materials because of concern of milk contamination.

Summary of Types and Origin of possible contaminating materials: You should be able to recognize the different types and origins of materials which may be involved in the contamination of milk. These may be classed and described as follows:

- I. Agents used in the treatment of animal diseases
  - A. Antibiotics
    1. Bacitracin
    2. Chloromycetin
    3. Chlortetracycline (aureomycin)
    4. Neomycin
    5. Oxytetracycline (terramycin)
    6. Penicillin
    7. Streptomycin
    8. Tetracycline (acromycin or polyotic)
    9. Tyrothricin
  - B. Other chemo-therapeutic preparations
    1. Nitrofurans (furacin)
    2. Phenothiazine
    3. Sulfa drugs
- II. Other materials related to dairy farm operation
  - A. Detergents
    1. Alkaline cleaners
    2. Acid milk stone removers
  - B. Sterilizing compounds
    1. Hypochlorites
    2. Iodophors
    3. Quaternary ammonium compounds