

**Development of a HACCP-Based
Chemical Residue Risk Reduction Program
For Turkey and Poultry Production and Processing**

TABLE OF CONTENTS

Preface	.....	1
I. Introduction	.....	3
II. Overview of Hazards Assessment and Critical Control Points (HACCP) Programs	.....	5
A. HACCP concepts		
B. HACCP principles		
C. HACCP implementation steps		
III. Use of HACCP in Developing and Implementing Chemical Residue Risk Reduction Program for Turkeys and Poultry	.....	10
A. Defining the objective		
B. Describing the process (turkey and poultry production/processing)		
C. Characterizing/quantifying the hazards/risks of chemical residues in turkey and poultry production		
1. defining "hazard" and "risk"		
2. potential chemical residues from commercial pesticides/industrial chemicals		
3. "high risk" chemical residues		
4. potential sources of chemical residue exposure in turkey and poultry		
5. characterizing regulatory approaches to chemical residues		
6. quality of the analytical results		
D. Determination of "Critical Control Points" (CCPs) for chemical residue contamination in turkey and poultry		
1. Primary organochlorine compounds		
2. Testing for chemical residues in turkey and poultry tissue		
3. Testing for chemical residues in certain feed ingredients		
4. Quality of the analytical screen		
E. Establishing control of parameters		
F. Monitoring and record keeping		

G. Establishing procedures for corrective action	
H. Other HACCP implementation procedures	
IV. Assessment of Various Approaches to a HACCP-based Risk Reduction Program for Chemical Residue Contamination	.....33
A. Testing turkey and poultry adipose (fat) tissues (from partial to 100% testing)	
B. Testing feed and feed ingredients (from partial to 100% testing)	
C. Testing both turkey and poultry tissues and feed/feed ingredients	
V. Recommended HACCP-Based Risk Reduction Program for Chemical Residue Contamination	.....40
A. Introduction	
B. The Selection of "Critical Control Points" (CCPs)	
C. Summary of Recommended HACCP-Based Plan	
VI. Appendix	.....44
A. Table 1 - Summary of Tolerances for Chlorinated Pesticides and other Compounds	
B. Table II - List of Chlorinated Hydrocarbons included in USDA Laboratory Accreditation	
C. Table III - Summary of Compounds Included in Diversified Laboratories' chlorinated pesticide/chlorinated hydrocarbon list	
D. Table IV - Procedures for sampling and shipping turkey and poultry tissue samples for chemical residue analysis.	

PREFACE

This document is intended to provide insight and information on the establishment of a HACCP-based chemical residue risk reduction program for the production and processing of turkey and poultry products. The information provided here represents the summation of nearly thirty years of experience by Diversified Laboratories' staff in (1) assisting in the resolution of chemical residue contamination problems in the field, (2) conducting research on improved analytical procedures and identifying sources of chemical residues, and, (3) providing comprehensive chlorinated pesticide/chlorinated hydrocarbons analyses for a large segment of the turkey and poultry industries and for a wide range of other companies in the agricultural industry.

Overview of HACCP -

Following a brief introduction, Section II of this document provides an overview of Hazards Assessment and Critical Control Points (HACCP) programs. This includes a brief discussion of HACCP concepts, HACCP principles, and HACCP implementation steps that should be followed when developing of a HACCP-based program for any purpose.

HACCP-Based Chemical Residue Program -

Section III of this document provides information regarding the implementation of a HACCP-based program as it specifically relates to chemical residue contamination in the production and processing of turkey and poultry. The risks and hazards associated with chemical residue contamination in turkey and poultry are discussed and, most importantly, the "Critical Control Points" (CCPs) for chemical residue control in turkey and poultry operations are identified.

Evaluation of the Basic Approaches Taken by the Turkey and Poultry Industry -

Many companies in the turkey and poultry industries already have ongoing quality assurance/quality control programs which employ various approaches to chemical residue monitoring. Section IV assesses the effectiveness of these approaches from the standpoint of the cost versus the benefit in terms of risk reduction. These approaches tend to emphasize the screening of feeds and feed ingredients, the screening of turkey and poultry tissues, and a combination of these two approaches in a regular testing program. The critique of the approaches in this section provides information on both the advantages and the disadvantages as measured by cost and reduction in risk of chemical residue contamination.

Recommended HACCP Program for Chemical Residue Risk Reduction -

Section V represents Diversified Laboratories' recommendations for designing and establishing a chemical residue program based on HACCP concepts and HACCP principles. The recommendations are intended to achieve the greatest possible reduction in risk from chemical residue contamination at the lowest possible cost. In developing the ideal program, it is incumbent upon the management of each operation to evaluate and determine the optimum combination of cost and benefit (i.e., degree of risk reduction) that is consistent with the philosophy and the objectives of their respective companies and the turkey and poultry industries as a whole. We believe the recommendations made in this document satisfy these considerations.

Section I - Introduction

This document is intended to provide guidance on the use of the concepts and principles of Hazard Analysis Critical Control Points (HACCP) in the development of a chemical residue risk reduction program for the production and processing of turkey and poultry products. The use of HACCP concepts and principles for developing a program that reduces the risks of chemical contamination in turkey and poultry is ideal since it provides both the broad perspective and the specific considerations that should be addressed when establishing a program to prevent chemical residue contamination in food products destined for human consumption.

This document briefly reviews the concepts and principles of HACCP and then introduces, sequentially, the important steps that should be followed in developing and implementing a HACCP-based program for chemical residue risk reduction. A major objective during the development of a HACCP-based program is determining the "critical control points" (CCPs) that represent the basis for the entire risk reduction program.

Finally, the document includes a description and assessment of the basic approaches that integrated turkey and poultry operations have taken in the past for HACCP-based chemical residue risk reduction programs, together with a recommended approach designed to optimize risk reduction with cost effectiveness. Since a HACCP program encompasses virtually all aspects of Good Management Practices (GMP), as related to quality assurance/quality control matters, this document uses HACCP as a designation for both HACCP and GMP.

Section II - Overview of Hazards Assessment and Critical Control Points (HACCP) Programs

A. HACCP concepts

The concept of Hazard Analysis Critical Control Points (HACCP) is summarized in Table 1. Although HACCP is a preventative approach to quality assurance/quality control, it is a risk-based system which is intended to provide optimum control and not absolute or maximum control. That is, there are risks in everything we do on a daily basis, and although we may reduce or minimize risks, they can never be totally eliminated. Further, there is generally a cost associated with risk reduction and a reasonable point of diminishing returns that must be determined. This fact is acknowledged under HACCP and it is clear that HACCP-based plans are designed to achieve that optimum point between the greatest possible reduction in risk at the lowest reasonable cost. It is also important to understand that HACCP encompasses the concepts and principles of "Good Management Practices" (GMP), and there should be a continual consideration of GMP as a HACCP-based plan for chemical residue risk reduction is developed and implemented.

Table 1

Concept of Hazard Analysis Critical Control Points (HACCP)

- **HACCP is a preventative approach to quality control**
 - **HACCP represents a risk-based system of quality control**
 - **HACCP is intended to provide optimum control, not maximum control**
 - **HACCP encompasses the concept and principles of "Good Management Practices" (GMP)**
-

B. HACCP principles

The principles of HACCP are summarized in Table 2. It is important to note that the HACCP principles define a program that is both comprehensive and flexible. That is, it is comprehensive in that HACCP addresses all areas or points of activity in the production sequence. At the same time, HACCP programs are intended to be site-specific and therefore must be adjusted or "customized" for each specific site of each individual operation. As a result there is also flexibility in following the implementation steps and establishing the controls of the generic HACCP guidance and these may be adjusted as deemed necessary by industry sector or by individual companies or operations within a given industry sector. It is also important to note that the determination of "Critical Control Points" (CCPs) is a key step, if not *the* key step, in implementing a HACCP plan. It is the CCPs that represent the basis for a HACCP-based quality assurance/quality control program. Another important principle is the fact that HACCP applies to more than finished products.

Table 2

Principles of Hazard Analysis Critical Control Points (HACCP)

- **HACCP programs are site-specific**
 - **HACCP addresses any area/point in the production sequence**
 - **Generic HACCP implementation steps/controls may be adjusted as necessary**
 - **Determination of the "Critical Control Points" (CCPs) is a key step in implementing a HACCP plan**
 - **HACCP applies to more than finished products**
-

C. HACCP implementation steps

The steps that should be followed in developing a HACCP program, including a chemical residue risk reduction program, are summarized in Table 3. The steps should be addressed sequentially and in sufficient detail to meet the intent of a HACCP-based plan as well as meet the guidance for GMP. Both the approach to, and the results obtained from, following each of these steps may vary somewhat among companies, based on their facilities, personnel, infrastructure and other factors. However, each step should be carefully considered and the approaches taken to carry out each individual step carefully well-defined. Each of the steps shown in Table 3 should be addressed in a manner that specifically relates to chemical residue contamination during the production and processing of turkey or poultry in an integrated operation.

Table 3

Steps in Developing a HACCP Chemical Residue Program

- 1. Define the objectives**
- 2. Describe the process**
- 3. Characterize the hazards and risks**
- 4. Determine the critical control points (CCPs)
control parameters**
- 5. Monitor and record**
- 6. Establish corrective action**
- 7. Establish documentation**
- 8. Establish verification procedures**
- 9. Develop a procedures manual, conduct
audits and reviews**

Section III - Use of HACCP in Developing and Implementing a Chemical Residue Risk Reduction Program for Turkey and Poultry

This section follows sequentially the individual HACCP steps for the development and implementation of a chemical residue risk reduction program for turkey and poultry. As presented here, each of the HACCP steps focuses specifically on a "typical" integrated turkey or poultry operation. To the extent that a particular operation differs significantly from those typically found in the industry, adjustments may be necessary.

A. HACCP STEP 1 - Defining the objective

The first step in developing a HACCP program for chemical residue risk reduction is to define the objective. The objective is to consistently produce finished turkey and poultry products with no chemical residues of concern or with chemical residues that are present at levels below published regulatory tolerance levels, including "zero" tolerance levels where this is applicable. As discussed later in this document, the principal chemical residues of concern are the chlorinated pesticides, as well as their isomers and metabolites and other chlorinated hydrocarbons such as polychlorinated biphenyls and other halogenated industrial chemicals. These chemicals are of principal concern because of their persistence in the environment, their ability to readily bioconcentrate in the adipose (fat) tissues of turkey, poultry and livestock, and because many chlorinated compounds are suspect carcinogens (cancer-causing agents) in humans at very low dietary levels.

B. HACCP STEP 2 - Describing the process

The second step in the development and implementation of a HACCP plan is to adequately define the process. A summary of processes involved in the production and processing of turkey and poultry is shown Table 4. Although a more comprehensive description of the processes could be developed, it is not necessary for purposes of developing a chemical residue plan. Based on the history of chemical residue contamination in turkey and poultry, the potential for contamination during the delivery or transfer of turkey and poultry is virtually nonexistent. Additionally, with the exception of contamination of stored poultry tissue by volatile solvents or other compounds related to maintenance or refurbishment of facilities, the risk of chemical contamination during slaughter, further processing, and product storage, is minimal. It is important, however, to ensure that maintenance and refurbishing operations involving the use of volatile solvents or other volatile industrial chemicals are well-controlled and that volatile substances are not released to the air in areas involving processing or storage operations.

The primary focus for potential chemical residue contamination is during the grow-out period and is specifically linked to feed, water and external (industrial or environmental) sources of contamination. These potential sources of contamination will be discussed in more detail in Section III of this document.

The potential for chemical residue exposure to turkey and poultry and possible tissue contamination is greatest during the growout periods in both the brooder house and the grower/finisher building. It is clear that all other steps in the turkey and poultry production process provide little or no opportunity for exposure to chemical residues in terms of either dose level or period of exposure. Further, there is virtually no history of chemical residue contamination of starting poults delivered from a source or during movement between buildings or during live-haul to the processing plant. Finally, with the exception of the contamination of stored poultry with volatile chemicals emanating from materials used in the maintenance or refurbishing of facilities, there is no history of chemical residue contamination at the processing facilities. This source of contamination from volatile chemical substances is generally very readily detected due to foreign odors emanating from the turkey and poultry tissues.

Table 4

Overview of Turkey and Poultry Production and Processing

- **Poults delivered to farm from source**
 - **Growout period in brooder buildings**
 - **Moved to grower/finisher buildings**
 - **Growout period in grower/finisher buildings**
 - **Live-haul to processing plant**
 - **Slaughter/dressing operations**
 - **Further processing**
 - **Storage**
-

C. HACCP STEP 3 - Characterizing the hazards/risks of chemical residues

In order to attempt to characterize or possibly quantify the hazards or risks of chemical residues in turkey and poultry production, the effort may be broken down into five individual areas of consideration. They are summarized in Table 5 and discussed in terms on the following pages.

Before attempting to characterize or quantify hazards or risks, there must be a complete understanding of the terms "hazard" and "risk". Secondly, there must be an appreciation for the vast potential of chemical residues from pesticides and other industrial chemicals that exist in the environment. Third, the "high risk" pesticides and industrial chemicals must be clearly identified from the large number of existing or discontinued pesticides and industrial chemicals. Fourth, the potential sources of chemical residue contamination in turkey and poultry must be defined. Finally, a determination of the hazards and risks of chemical residue contamination must include an understanding of the regulatory approaches used by the USDA/FDA/EPA to control such contaminations.

Table 5

Characterizing Hazards/Risks of Chemical Contamination

- 1. Defining hazard and risk**
 - 2. Potential chemical residues from pesticides/industrial chemicals**
 - 3. Identification of the "high risk" pesticides and industrial chemicals**
 - 4. Potential sources of chemical residue contamination in turkey and poultry**
 - 5. Impact of the regulatory approaches on the risks of chemical residue contamination**
 - 6. Quality of the analytical results**
-

1. Defining Hazard and Risk

Although HACCP implementation Step 3 calls for quantifying the risks associated with the processes in the operation, it is difficult and generally impossible to quantify these risks. Rather, it is more reasonable to characterize both the hazards and the risks associated with the chemical residue contamination. Further, in order to fully understand the characterization of both the hazards and risks, the distinction between hazard and risk must be clearly understood.

As shown in Table 6, hazard is defined as the property of being dangerous, or representing a source of danger or the consequence of an event that takes place. For example, a chemical substance that has the property of being toxic, and therefore dangerous, is considered hazardous. If an individual were to be exposed to a toxic or hazardous substance, the consequences would be an adverse health effect or even death. Hence, the hazard may be thought of as the consequence of an event occurring, such as the consequence of exposing of an individual or an animal to a toxic or hazardous substance.

Risk may be defined as an interaction between the probability of an event occurring and the consequences (hazards) if the event occurs. If the probability of an event occurring is high and the consequences are significant, the risk is considered to be high. Also, if the probability of the occurrence of an event is low but the consequences of the event are very severe, then the risk also would be considered high. This relationship between hazard and risk is shown in an "equation-like" format in Table 6. For example, human health risks are considered to be high if the hazard or consequence is considered to be life threatening or results in a serious health effect, even though the probability of the occurrence may be low. Therefore, one must consider both the frequency of the event or the statistical probability of the event occurring and the degree of severity of the consequences if the event were to take place. In practical terms, the consequences of a chemical residue contamination problem in turkey and poultry would be severe in terms of the economic impact on the company. Therefore, the risk is considered high even though the frequency of occurrence may be low.

Although guidelines for most HACCP programs include a step for quantifying the hazards and the risks, it is believed that it is more realistic to characterize the hazards and risks associated with chemical residue contamination since it is not possible to quantify them per se. However, the aspects of a chemical residue risk reduction program that are quantifiable include the actual levels of chemical residues present in the turkey and poultry tissues and the estimate of the financial impact on the company if turkey or poultry products had to be recalled. The cost of such an action in terms of direct costs of recovering the product, the loss of the product, and the impact on the company image may well reach several million dollars.

Table 6

Defining Hazard and Risk

Hazard = the consequences of an event, a source of danger

**Risk = probability of the X consequences of an
occurrence of an event (hazard)
event**

2. Potential Chemical Residues from Pesticides/Industrial Chemicals

When considering the various hazards and risks associated with chemical residues the vast number and variation in types of potential chemical residues must be considered. These are summarized in Table 7 and indicate that approximately 600 pesticides, insecticides, and rodenticides are registered in EPA's Office of Pesticide Programs and that over 65,000 industrial chemicals are listed by EPA under the Toxic Substances Control Act. Further, there is a wide range of chemical classes used as both pesticides and industrial chemicals. It is clear that although many of these chemicals may represent potential contaminants in poultry and livestock, it is not economically feasible nor justifiable to routinely test for this number of compounds. Therefore, it is important to identify those chemical substances that represent the highest potential for hazards and risks.

Table 7

Potential Chemical Residues from Pesticides/Industrial Chemicals

- **Approximately 600 pesticides, insecticides and rodenticides registered by EPA's Office of Pesticide Programs**
- **Over 65,000 industrial chemicals present on EPA's list of industrial chemicals under the Toxic Substances Control Act (TSCA)**
- **Wide range of pesticide chemicals**
 - organophosphate pesticides
 - phenoxy acid herbicides
 - triazine herbicides
 - organochlorine pesticides
 - other
- **Wide range of industrial chemical classes**
 - non-halogenated hydrocarbons
 - chlorinated hydrocarbons
 - brominated hydrocarbons

3. Identification of "High Risk" Pesticides and Industrial Chemicals

Based on comparisons of the physical, chemical, and biological (toxicological) properties of all chemical classes and individual chemicals that represent potential residues in turkey, poultry and livestock, the truly "high risk" chemicals are the organochlorine pesticides and other chlorinated industrial chemicals. The properties of these chlorinated substances are somewhat unique and increase both the probability of an occurrence of contamination as well as the severity of their impact as related to human health concerns. These properties are summarized in Table 8.

In general, the fact that most chlorinated chemicals are carcinogenic (cancer-causing) at extremely low levels and readily bioconcentrated in turkey, poultry and livestock tissues is the reason for the major concern of the regulatory agencies. Further, it is generally not well understood that this diverse group of chlorinated pesticides and chlorinated industrial chemicals also represents a large number of substances that far exceeds the typical list of chlorinated pesticides found in most commercial laboratory screening programs.

Table 8

Identification of "High Risk" Pesticides and Industrial Chemicals

- **Organochlorine pesticides and other chlorinated hydrocarbons are highly persistent in the environment and are readily stored and concentrated in poultry and livestock tissues.**
- **Organochlorine pesticides and other chlorinated hydrocarbons are likely to be carcinogenic at very low levels and represent a major concern for human health.**
- **Large numbers of organochlorine pesticides and other chlorinated hydrocarbons, as well as their isomers, metabolites, and partial degradation products are present in the environment and represent potential residue contaminants in poultry and livestock.**
- **Routine laboratory testing programs for chlorinated pesticide/chlorinated hydrocarbon residues in agricultural products are generally inadequate.**
- **Historical events support the probability of future chlorinated pesticides/chlorinated hydrocarbon residue contaminations at all levels of the food chain.**
- **The economic impact of a chemical residue contamination problem can be substantial.**
- **The risk, as well as the burden to reduce the risk, is placed primarily on individual companies throughout the agricultural industry at all levels of the food chain.**

Chlorinated substances are considered hazardous because they are generally carcinogenic (or cancer causing) compounds and are therefore toxic at extremely low dose levels. From the standpoint of risk, it is known that large numbers of chlorinated substances exist in commerce and the environment, are highly persistent in the environment, and bioconcentrate in living organisms such as turkey and poultry. Further, the number of these substances in existence is increased by the fact that many of these substances can undergo chemical structure alteration through photolysis, hydrolysis, oxidation and microbial degradation in the environment and may be structurally altered through metabolism by higher animals. As a result of this increased number of hazardous substances there is an increased probability of chlorinated compounds appearing in the food chain. This is substantiated by the historical record of contamination problems with chlorinated pesticides and other chlorinated hydrocarbons in feed ingredients, feeds, and the tissues of turkey, poultry and livestock.

Finally, the risk is increased since the number of chlorinated compounds of both pesticide origin and industrial chemical origin that have been identified in the food chain far exceed the list of chlorinated pesticides included in most commercial laboratory screening programs. This is discussed further under number 6 in this section.

4. Potential Sources of Chemical Residue Contamination in Turkey and Poultry

As shown in Table 9 there are numerous and diverse sources of potential chemical residue contamination in turkey and poultry during the growout period. The exposure to chemical residues may result from ingestion, inhalation (inspired particulate matter) or dermal absorption. In most instances, oral ingestion is the primary route of exposure. Further, although there appear to be numerous sources of potential exposure, historically it has been shown that feeds, feed ingredients, and spray applications (made by farm management or overspray from surrounding operations) represent the principle sources of chemical contamination observed in the past. Drugs and medications are also likely to result in residue contamination above regulatory levels and should therefore be dealt with accordingly. The approaches to reducing the risks of drug residue contamination are well-known and more under the control of the operation than other forms of chemical residue contamination. In these instances, the identity of the chemical substance, the specific dates of exposure, and the dose levels are all known and termination of exposure can be carefully controlled.

Table 9

**Potential Sources of Chemical Residue Contamination
in Turkey and Poultry through Ingestion, Inspired
Particulate Matter or Dermal Absorption**

- **Feeds and feed ingredients**
- **Litter**
- **Drinking water**
- **Disinfectants, pesticides, etc. used by grower**
- **Overspray of pesticides, etc. from surrounding operations**
- **Toxic chemicals from industrial/commercial emissions and disposal**
- **Drugs and medications (e.g., sulfonamides)**
- **Other**

5. Impact of Regulatory Approaches on the Risks of Chemical Residue Contamination

The risk of chemical residue contamination, particularly chlorinated residues, may also be characterized and evaluated by their regulatory status and the approaches taken by the regulatory agencies. The important aspects of the regulatory approach to chemical residue are summarized in Table 10.

Regulatory agencies have a high level of concern for chlorinated compounds because of their potential carcinogenic effects and there is continual, random monitoring for these chemical residues by the U.S. Department of Agriculture (USDA). The risk to turkey and poultry operations is increased by the fact that it is not possible for the agencies to publish a definitive list of chlorinated compounds to help companies clearly understand the limits of their responsibility. Additionally, there is a relatively small number of chlorinated compounds, primarily chlorinated pesticides, for which tolerance levels have been published (see Table I in the Appendix). All other compounds are considered to have "zero" tolerance levels and levels above "zero" would be established only on a case-by-case basis. Since the regulatory agencies generally use the criterion of "unavoidable contamination" as the basis for establishing tolerance levels other than "zero" tolerance levels, it is not likely that individual companies will be granted special tolerance levels for isolated instances of contamination. Finally, the USDA laboratory certification program check samples used to measure and monitor the capability of the commercial laboratories have been limited to eleven chlorinated pesticides, isomers and metabolites and only two PCB products, Arochlor 1254 and Arochlor 1260. (See Table II in the Appendix.) As a result, many laboratories are not familiar with many other chlorinated pesticides, isomers and metabolites or other chlorinated hydrocarbons that have been found in the food chain and consequently, these laboratories fail to report their presence. Therefore, it is important to be aware that both the risk and the burden of avoidance of chemical residue contamination from a large number of chlorinated compounds is placed on each individual company in the industry.

Table 10

**Impact of Regulatory Approaches on the Risks
of Chemical Residue Contamination**

- **Ongoing random monitoring of poultry/livestock tissues by USDA.**
- **No definitive list of chemicals published to identify all chemical residues of concern to, or regulated by, federal agencies.**
- **Chemical residue tolerance levels have been published for only a limited number of chemicals.**
- **No supplementary list of all chemical isomers and metabolites of concern has been published for those pesticide chemicals with established tolerance levels even though the government tolerance levels are usually based on the sum of the parent chemical, and its isomers and metabolites.**
- **"Zero" tolerance levels exist for all chemicals of concern to the regulatory agencies in instances where no tolerance levels have been published.**
- **Tolerance levels for chemicals with no published levels are established "case-by-case" and based primarily on a judgement of "unavoidable contamination." It is not likely that special tolerance limits for isolated cases will be granted.**
- **Regulatory actions taken in the past have generally involved recalls and/or a ban on the sale of product.**
- **The USDA laboratory certification program is limited in scope since the same 11 pesticides and 2 Arochlor products are continually included in check samples.**

6. Quality of the Analytical Results

The final consideration under the characterization and quantification of hazards and risks concerns the quality of the analytical results. The important considerations are summarized in Table 11.

Table 11

Quality of the Analytical Results

- **Comprehensive nature of the analytical screen**
 - **i.e., number and type of substances included in the screen**
- **Limits of detectability**
- **Characterization of the QA/QC program**
 - **technical personnel qualifications**
 - **use of standards and calibration procedures**
 - **confirmational methods (GC/MS)**
 - **data review and sign-off**
- **Timeliness of analytical results**
- **Availability of qualified technical support**

The comprehensive nature of the analytical screen - This relates to the number and type of chemical substances routinely included in the analysis. It is well established that a large number of chlorinated pesticides, isomers, metabolites, and other chlorinated hydrocarbons (industrial chemicals) are present in the environment and can therefore enter the food chain. Further, a significant number of chlorinated compounds have been found to be present in agricultural or food products that are not included in the typical pesticide screen. Therefore, to minimize the risk of chemical residue contamination, the routine analytical screen should include all chlorinated pesticides and other chlorinated industrial chemicals that have been found in agricultural products in the past. Based on many years of analytical experience and research investigations, Diversified Laboratories has identified at least 60 chlorinated pesticides or chlorinated industrial chemicals that have been found in agricultural products and subsequently added to the routine pesticide screen. These chemicals have been either completely or partially identified in structure and are listed in Table III in the Appendix. Analytical methods and procedures that have not been specifically designed to include all of these chemicals will erroneously report that certain chemical residues of concern are not present in the turkey and poultry tissues or feed ingredients. The reporting of such "false negative" results could lead to substantial problems related to a chemical residue contamination incident.

Limits of Detectability - The limits of detectability are extremely important since only a small percentage of chlorinated pesticides and chlorinated hydrocarbons have established regulatory tolerance levels. All other substances of concern have "zero" tolerance levels as defined by the regulatory agencies. This means that chlorinated substances that are found at detectable levels in regulatory agency laboratories may be subject to regulatory action. This problem is greatly magnified by the practice of pooling various analytical samples as an economic measure. In this instance, greatly enhanced analytical procedures must be developed and employed in order to ensure that "zero" tolerance levels are met for individual samples that have been analyzed as a portion of a pooled sample.

Characterization of the QA/QC Program - The quality of the analytical results both qualitatively and quantitatively is also extremely important. The important considerations here include (1) training and experience of personnel conducting the analysis and reviewing and approving the analytical results, (2) methods of analyte extraction and purification, (3) use of standards including internal standards, matrix standards, calibration standards, and the calibration and tuning of equipment, (4) availability of confirmational methods including gas chromatography/mass spectrometry (GC/MS) and, (5) the procedures and personnel involved in the data review and sign off of final results. The rigorous application of these 5 policies and procedures will insure results that are free of "false negatives" and "false positives".

Timeliness of Analytical Results - The timeliness of the analytical results is also equally critical. Analyses of turkey and poultry tissues should be completed and reported prior to the actual processing of the turkey and poultry in order to minimize any logistical or economic problems associated with a flock of turkey or poultry found to be contaminated with a chemical residue. Additionally, the analytical results on feed ingredients should be available before or at the time that materials are received by the feed mill. This time frame would prevent the manufacture and shipment of contaminated feed to growout operations. This can be accomplished by insisting that suppliers test their products for chlorinated pesticides and other chlorinated hydrocarbons prior to shipment of the product and present a copy of the analyses at the time of delivery.

Availability of Qualified Technical Support - It is important to consider the availability of qualified scientists and technicians at the laboratory level to provide timely and informative response to questions related to possible chemical residue contamination. This should include information on the analyses conducted, the presence of unidentified compounds of concern, the confirmation of the presence of chlorinated compounds of concern, and recommendations on approaches for the quick resolution of a chemical residue contamination problem. Further, the appropriate scientific capabilities should be available to continually update and maintain a comprehensive pesticide/hydrocarbon screen that minimizes the risk of chemical residue contamination.

D. HACCP STEP 4 - Identification of Critical Control Points (CCPs) for Chemical Residue Contamination in Turkey and Poultry Tissues

After successful completion of the first three implementation steps of a HACCP program, namely: (1) defining the objective, (2) describing the processes of turkey and poultry production and, (3) characterizing the hazards and risks of chemical residue contamination, the "Critical Control Points" or CCPs for chemical residue contamination in turkey and poultry can be determined. Based on Diversified Laboratories' nearly 25 years of experience in providing support to companies with chemical residue contamination problems and analyzing tens of thousands of agricultural samples, we have identified four Critical Control Points for chemical residues in the production and processing of turkey and poultry. These Critical Control Points are summarized in Table 12.

Table 12

**Critical Control Points Identified for a
HACCP Program for Chemical Residues
in Turkey and Poultry Production and Processing**

- **Primary focus on organochlorine compounds as chemical residues of concern**
 - chlorinated pesticides
 - chlorinated industrial chemicals
- **Status of chemical residues in turkey adipose (fat) tissues at time of slaughter.**
- **Status of chlorinated chemical residues in those feed ingredients with a history of contamination.**
- **Quality of the laboratory analysis**
 - comprehensive nature of the analytical screen
 - limits of detectability
 - QA/QC of the analytical procedures
 - timeliness of the analytical results
 - availability of qualified technical support

Description of Identified Control Points (CCPs)

CCP 1 - Primary Focus on Organochlorine Compounds

The first Critical Control Point or CCP is the primary focus on organochlorine compounds. This includes chlorinated pesticides, isomers, and metabolites and other chlorinated industrial chemicals that have inadvertently found their way into agricultural products during the past fifteen years. The chlorinated compounds have been singled out because they are highly persistent in the environment, readily bioconcentrate in poultry and livestock, and are toxic to humans at extremely low levels due to their carcinogenic (cancer-causing) effects. The adverse nature of chlorinated, or more broadly, halogenated compounds is discussed in more detail under Section III, C-3 of this document.

CCP 2 - Status of Chemical Residues in Turkey and Poultry Tissues

The screening of turkey and poultry adipose (fat) tissues for confirming the absence of chemical residues at levels of concern prior to slaughter represents the second Critical Control Point (CCP). This CCP is extremely important since it monitors turkey and poultry tissues for chemical residue contamination from virtually all exposure sources and prevents the processing of contaminated products destined for human consumption. This CCP represents the ultimate control point since turkey tissues cleared at the time of slaughter have been subjected to all of the most likely sources of exposure and are virtually assured to be free of chemical residues as finished food products. Further, the adipose (fat) tissue represents an excellent sample matrix for testing, since the chlorinated chemical residues readily bioconcentrate in this tissue. The only caveat regarding this control point is that it does not exclude the contamination of processed turkey, turkey products and poultry that may have been exposed to volatile commercial chemicals during storage or transport to market.

One of the principle issues associated with this CCP is the time frame between adipose tissue sampling and the actual slaughter of the turkey and poultry. Additionally, it is preferable to sample the tissues in the field (approximately three to five days prior to slaughter) rather than attempt to obtain samples at the processing plant. The latter approach invariably results in the availability of analytical results after the turkey and poultry products have left the processing facility, thereby creating major problems in the event of a recall due to chemical residue contamination.

CCP 3 - The Status of Chemical Residues in those Feed Ingredients With a History of Contamination

The third CCP is the testing for chemical residues in certain feed ingredients. Historically, the principle feed ingredient associated with chemical residue contamination have been feed grade fats and oils used in poultry and livestock rations. Because chlorinated pesticides and chlorinated industrial chemicals are readily soluble in fats and oils, they tend to concentrate in these materials and, therefore, represent a means of exposure from dietary sources. Although other ingredients such as fish meals and animal byproduct meals may also tend to have measurable levels of chemical residues, they are generally not as important as the fats and oils in contributing to chemical residue contamination. It is important to point out here that this CCP is not as "critical" as the testing of the turkey tissue. First, the tissue screening represents a much broader monitoring mechanism for chemical residue contamination. Secondly, many suppliers have instituted their own chemical residue testing program and are willing to provide this information to the feed mill on a timely basis. Since each integrated turkey or poultry operation and feed manufacturing facility tends to be somewhat unique with respect to suppliers, etc., it is important to establish procedures for potential contamination from of feed ingredient sources on a case-by-case basis.

CCP - 4 Quality of the Laboratory Analysis

The fourth and last CCP is the quality of the laboratory analyses. In this instance, each of the criteria previously discussed under Section III, C-6 regarding the quality of the analytical screen should be carefully evaluated to insure that the quality of analyses required to substantially reduce the risk of chemical residue contamination is achieved and maintained.

The important elements in this CCP are (1) comprehensive nature of the analytical screen (the number and types of chemicals included in the routine screen), (2) the limits of detectability, (3) the details of the QA/QC program routinely employed, (4) the timeliness of the analytical results, and (5) the availability of qualified technical support.

E. HACCP STEP 5 - Control Parameters for Chemical Residues

Certain of the control parameters for chemical residues are relatively simple and straight-forward since they are established and enforced by the regulatory agencies, USDA, FDA, and EPA. Hence, the control parameters include the tolerance levels that have been published for certain chlorinated pesticides and PCBs as well as "zero" tolerance levels for all other chlorinated compounds that do not have published tolerance levels.

A summary of the tolerance levels for a select number of pesticides published by the USDA is shown in Table I in the Appendix. It can be noted that in certain cases the isomers and metabolites of some pesticides are included in the tolerance level on an aggregate basis. Generally, the isomers and metabolites will be included in the quantification of the contaminating substances for virtually all pesticides even if the isomers or metabolites have not been identified or included in this published list.

The other important control parameter for chemical residues is the identification of the chemicals of concern, or more specifically, the chemicals that may trigger regulatory action. This represents the most difficult of the control parameters since the regulatory agencies do not provide a definitive list of chemicals of concern. Therefore, in the absence of a definitive list, all chlorinated hydrocarbons are potentially chemicals of concern from a regulatory standpoint. This places the burden of responsibility on the individual companies since there are large numbers of chlorinated hydrocarbons that have the potential to enter the food chain and, hence, contaminate turkey and poultry tissues. The ultimate responsibility for tissue residue contamination by any of these compounds lies with the producer of the turkey and poultry products destined for human consumption. The only approach that appears practical and economically feasible is to extend the pesticide screen to include at least those chlorinated pesticides and other chlorinated hydrocarbons that have been identified previously in the food chain. The inclusion of these substances is logical since it addresses the statistical probability that substances already found in the food chain are most likely to appear again. A list of sixty (60) substances that have been included in Diversified Laboratories' chlorinated pesticide/chlorinated hydrocarbon screen for the routine analyses of tissues, feeds, feed ingredients, etc. is shown in Table III in the Appendix.

F. HACCP STEP 6 - Monitoring and Record Keeping of Chemical Residue Data

The next step in implementation of a HACCP program for chemical residue analyses is the monitoring and the recordkeeping of data on chemical residues. In this step it is important to establish and maintain a consistent sampling and analytical testing regimen for chemical residues. Random sampling and analyses provide only limited control. Additionally, the results of chemical residue analysis should be systematically recorded by type and source of sample matrix such as tissues, feeds, feed ingredients, etc. The records and data should be organized in a format that enables the assessment of trends or patterns that may develop within specific farms, among various farms or within a specific material type and source. This information is useful in evaluating feed ingredient suppliers, characteristics of individual grower operations, and any possible trends, cyclical variations or other patterns that may become apparent. It is important to highlight analytical results indicating the presence of chemicals of concern and particularly those chemical residues present near or above regulatory tolerance levels. Finally, it is important to note any problematic trends such as a progressive increase in the concentration of a chemical residue of concern over time or the sudden appearance of even low levels of a chemical of concern or an unidentified substance in one or more turkey and poultry flocks or feeds at about the same time. These observations may indicate and forewarn of the onset of contamination problems, which can be avoided or minimized with the rapid implementation of the appropriate measures.

G. HACCP STEP 7 - Corrective Action For Chemical Residue Levels of Concern

The need for corrective action based on analytical results indicating the presence of concern levels of chemical residues is necessary to minimize the economic impact or other potential damage created by a residue contamination. In general, the same procedures are employed whether the contamination is found in a feed, feed ingredient, or in the turkey and poultry adipose (fat) tissues.

A summary of the generic approach includes the following:

1. Isolation of the problematic material whether it be a feed ingredient, finished feed, flock of turkey or poultry, etc.
2. Validation of the chemical residue contamination by resampling and retesting the material as quickly as possible to ensure that no inadvertent contamination has taken place during sampling or packaging for shipment.
3. If the analytical results are validated, initiate appropriate steps for appropriate disposition, including safe disposal, of the material in question.
4. In all cases of significant chemical residue contamination, undertake an initiative immediately to identify the origin or source of contamination and eliminate it.
5. Increase the monitoring of future materials (i.e. feed ingredients, feeds, turkey and poultry tissues, etc.) as deemed necessary in order to ensure no future contamination from the identified source or similar sources.

H. HACCP STEPS 8, 9, and 10 - Other HACCP Implementation Procedures for Chemical Residues Avoidance

The remaining HACCP program implementation procedures include: (1) establishing verification procedures involving management oversight of the program, (2) the development of an operating procedures manual which addresses all facets of the program, and (3) the establishment of audit, review and employee training programs to ensure the consistency and quality of the program. It is not considered necessary to elaborate on these procedures in this report since each of these procedures are associated with Good Management Practices (GMP) and are well known to the managements of most companies in the turkey and poultry industries.

Section IV - Evaluation of Current Approaches Taken By the Turkey and Poultry Industries to Avoid Chemical Residue Contamination

Introduction

To date, integrated turkey and poultry operations have used various approaches to prevent and/or detect chemical residue contamination in turkey and poultry products. Those operations favoring approaches to prevent chemical residues from being deposited in turkey and poultry tissues tend to emphasize the testing of feeds and feed ingredients. The operations favoring approaches that screen chemical residues in turkey and poultry tissues, and thereby prevent contaminated products from reaching the consumer, tend to emphasize the testing of turkey and poultry flocks before or at the time of slaughter. Certain operations have elected to combine some testing of feeds and feed ingredients with selected screening of turkey and poultry flocks.

Although there are many different approaches to a chemical residue program that can be, and have been, adopted by integrated turkey and poultry operations, this section attempts to assess the advantages and disadvantages of the three basic approaches. They include: (1) the screening of feed and feed ingredients, (2) the screening of turkey and poultry tissues, and (3) a combined screening of selected feeds, feed ingredients and turkey and poultry flocks.

The critique of these approaches is based on more than twenty-five years of experience by Diversified Laboratories' staff in assisting in the resolution of chemical residue problems in the field, identifying unknown substances in agricultural products, improving the quality of analytical procedures, and providing comprehensive pesticide/hydrocarbon analyses to a large segment of the turkey and poultry industries and a wide range of other companies in the agricultural industry.

A. The Evaluation of Programs that Screen Both Feeds and Feed Ingredients for Chemical Residues

1. Summary Description

Under this approach, feeds and feed ingredients are tested as a means of monitoring for chemical residue contamination. The rationale for this approach is based on the fact that contaminated feed or feed ingredients historically have represented the principal source of contamination of turkey, poultry and livestock tissues. Most turkey and poultry operations that employ this approach believe that it represents a true prevention program since it is designed to prevent the chemical residues from being deposited in the tissues of the turkey and poultry. However, our experience indicates that these programs are designed to randomly or selectively test only a portion of the incoming feed ingredients or outgoing finished feeds. In some instances, the program is designed to focus on specific feed ingredients, such as fats and oils, that historically have been known to contaminate turkey, poultry and livestock feeds.

2. Advantages of a Program Based on Screening Feeds or Feed Ingredients:

- a. Focuses on principal source of chemical residue contamination in turkey, poultry and livestock based on historical information.
- b. Represents a prevention program at the basic level; that is, it attempts to identify and eliminate chemical residues before there is contamination of the turkey tissues.
- c. Avoids the costs associated with testing turkey and poultry tissues in each flock.

3. Disadvantages of a Program Based on Screening Feeds or Feed Ingredients:

- a. Because of the large number of feed ingredient shipments and the individual batches of feed produced, a comprehensive (100%) screening program of feed or feed ingredients would be extremely expensive, would involve major logistical problems, and, to our knowledge, has never been adopted by any company in the turkey or poultry industries.
- b. A comprehensive (100%) feed or feed ingredient screening program does not protect against other potential sources of chemical residue contamination such as litter, drinking water, fugitive pesticide sprays, other environmental exposures, etc.
- c. A comprehensive (100%) feed or feed ingredient screening program does not provide

important data or information regarding actual chemical residues present in turkey and poultry tissues.

- (1) From time-to-time, feeds or feed ingredients may contain measurable levels of certain chemical residues. Although these chemical residues may be present below regulatory tolerance levels in the feed or feed ingredients, the final levels of these substances in turkey tissues will not be known since the exposure periods and the bioconcentration rates for specific chemicals in a given flock will not be known. The exposure periods may range from the consumption of one delivery of contaminated feed, to the consumption of contaminated feed for the life of turkeys and poultry. Additionally, the bioconcentration rate from feed level to tissue level may range from 4 fold to greater than 15 fold. This inability to correlate chemical residue levels in feed with the final levels in turkey and poultry tissues can represent problems both in instances where chemical residues have published tolerance levels and in cases where chemical residues have "zero" tolerance levels.
- d. A feed or feed ingredient screening program involving random or selected testing of a portion of the feed or feed ingredients is inadequate and only marginally reduces the risk of chemical residue contamination. Chemical residue contamination of feed ingredients is episodic and cannot be effectively monitored by a program that tests only a limited number of feed or feed ingredient samples.
 - e. A feed ingredient screening program involving the comprehensive (100%) testing of historically significant feed ingredients such as feedgrade fats and oils suffers from the same deficiencies previously described in disadvantages b and c above.

B. The Evaluation of Programs that Screen Turkey and Poultry Tissues for Chemical Residues

1. Summary Description

Under this approach, composite samples of turkey and poultry adipose (fat) tissue from individual turkey and poultry flocks are tested as a means of monitoring for chemical residue contamination. The rationale for this approach is based on the fact that the adipose tissue monitors for contamination from virtually all sources of chemical residue exposure to which the turkey and poultry may have been subjected. Further, it provides final documentation of the status of chemical residues in the turkey and poultry products destined for human consumption. Certain turkey and poultry operations test the flocks in the field prior to slaughter while other operations sample the tissues at the time of slaughter. Also, although many operations test 100% of all turkey and poultry flocks, certain companies test only a portion of the total flocks using random or other selection rationale as the basis for the sampling and testing procedure.

2. Advantages of a Program Screening Turkey and Poultry Flocks:

- a. If a comprehensive (100%) program is followed, the program provides a high degree of assurance that all processed meat is below published tolerance levels of chemical residues, including those chemicals with "zero" tolerance levels.
- b. If a comprehensive (100%) program for turkey and poultry flocks is followed, the program addresses the exposure to chemical residues from all potential sources of contamination, including feed, litter, drinking water, and industrial and environmental sources.
- c. Testing all turkey and poultry flocks represents a cost effective program since it requires less samples for testing and provides more useful, valid data than a program testing feeds/feed ingredients. For example, the screening of tissues from all flocks can serve as an indirect monitoring mechanism for detecting the onset of chemical residue exposure on a farm, at a feed mill, or by a specific feed ingredient. The presence of low-levels, or of progressively increasing levels, of a chemical residue in one or more turkey or poultry flocks may represent an early warning sign of the beginnings of a contamination problem that could be avoided if appropriate steps are taken.

3. Disadvantages of a Program Screening Turkey and Poultry Flocks:

- a. Represents an approach that does not directly prevent the chemical residue contamination of turkey and poultry but does prevent the distribution of contaminated turkey and poultry products for human consumption.

- b. Represents a significant cost in testing tissues from all flocks.
- c. If, the tissue screening program is not comprehensive (i.e., 100% of all flocks), there will be only a partial reduction in risk due to the inability of selected sampling methods to offset the episodic nature of chemical residue contamination.

C. Evaluation of Programs with Partial Screening of Turkey and Poultry Flocks and Feeds/Feed Ingredients

1. Summary Description

Under this approach, composite samples of turkey and poultry adipose (fat) tissue from selected flocks and samples of selected feeds or feed ingredients are tested as a means of monitoring for chemical residue contamination. In this instance, there is no comprehensive (100%) testing of either turkey and poultry flocks or feeds/feed ingredients because of the costs and logistics associated with such a program. Generally a random sampling technique or a schedule targeting a specific frequency of testing of each farm and each type of feed ingredient is established.

The rationale for this approach is based on the perceived advantage of screening both turkey and poultry flocks and feed ingredients although only some portion of each are actually tested.

2. Advantage of a Program Based on Screening Turkey and Poultry Tissues from Selected Flocks and Testing Selected Samples of Feeds/Feed Ingredients.

- a. Provides important and useful chemical residue data on those turkey and poultry flocks and those feeds or feed ingredients that are actually tested.
- b. Is generally a lower-cost program than programs that screen 100% of all turkey and poultry flocks or 100% of all feeds or feed ingredients.
- c. Program can be modified to increase the number of flocks or feeds/feed ingredients tested and thereby further reduce the risk of chemical residue contamination.
- d. The risk of chemical residue contamination can be more effectively reduced if the portion of testing on feeds/feed ingredients is restricted to those ingredients with a history of chemical residue contamination, such as feed grade fats and oils.

3. Disadvantages of a Program Based on a Partial Screening Turkey and Poultry Tissues from Selected Flocks and Testing Selected Samples of Feeds/Feed Ingredients.

- a. The cost of comprehensive (100%) testing of all turkey and poultry flocks and all feeds/feed ingredients is prohibitive and not practical.
- b. The cost of a program combining partial turkey and poultry tissue testing and partial feed/feed ingredient testing can equal or exceed the cost of a comprehensive (100%)

program for testing turkey and poultry tissues.

- c. Although there is a perception that combining a partial testing of turkey and poultry flocks with a partial testing of feeds/feed ingredients results in a synergistic reduction in the risk of chemical residue contamination, this is not the case. Due to the episodic nature of residue contamination and inability to develop sampling patterns that parallel contamination patterns, particularly in turkey and poultry flocks, the combined testing has little more than an additive effect on risk reduction.
- d. Partial screening of turkey and poultry flocks provides protection from all exposure sources for only those flocks tested. All other turkey and poultry flocks are at significant risk.
- e. Partial screening of feeds or feed ingredients provides protection for only those materials tested and has only marginal impact on reducing the risk of chemical residue contamination in turkey and poultry flocks whose tissues were not screened.

Section V - Recommendation for a HACCP-based Chemical Residue Risk Reduction Program for Turkey and Poultry Production and Processing

A. Introduction -

The chemical residue risk reduction program recommended here is based on more than 25 years of experience in direct assistance to companies with chemical residue contamination problems. The experience extends also to research and development efforts on the detection and identification of chlorinated pesticides, isomers, metabolites and other chlorinated hydrocarbons, and the maintenance of chemical residue programs for the turkey and poultry industry and for a wide range of other companies in the agricultural industry. The program recommended here has been designed to meet the concepts and principles of HACCP and to achieve the greatest possible reduction in risk of chemical residue contamination.

B. The Selection of "Critical Control Points" (CCPs)

The "Critical Control Points", or CCPs, represent the single most important data and information required for the development of a HACCP quality assurance/quality control (QA/QC) plan. They represent the specific areas of major focus within all phases of the operation that serve as the framework for the HACCP plan.

The four Critical Control Points (CCPs) that serve as the framework of the HACCP-based program recommended here were developed in Section III-D of this document using HACCP concepts and principals. These four CCPs include:

1. The focus on organochlorine compounds as the chemical residues of primary concern.
2. The status of chemical residues in the adipose (fat) tissue of turkey and poultry at the end of the growout period.
3. The status of chemical residues in certain feed ingredients with a history of contamination.
4. The quality of the laboratory analysis used to determine the status of chemical residues in turkey and poultry tissues and in certain feed ingredients.

C. Summary of Recommended HACCP-Based Plan

With the four Critical Control Points identified here and in Section III-D providing the basis for the approach, the proposed program is summarized below:

1. Selection of the Analytical Screen

The analytical screen should be comprised of chlorinated pesticides and chlorinated hydrocarbons since these substances represent the primary concern of the regulatory agencies, USDA, FDA, and EPA. They are chemically stable and highly persistent in the environment, readily bioconcentrate in the tissue of turkey, poultry and livestock, and promote chronic toxicity at very low levels due to their carcinogenic (cancer-causing) properties.

The analytical screen should contain all chlorinated pesticides, isomers and metabolites and all chlorinated hydrocarbons that have a "high probability" of contaminating turkey and poultry tissue. We have considered all chlorinated pesticides or chlorinated hydrocarbons that have been identified in feeds, feed ingredients and turkey, poultry or livestock tissue to represent the "high probability" chlorinated chemicals of concern. To date, they include approximately 60 completely or partially identified chemical substances and are listed in Table III of the Appendix. This list should be continually expanded as other chlorinated substances are found in agricultural products. In summary, the more comprehensive the chemical residue screen, the lower the risk of chemical residue contamination.

2. Testing of All Turkey and Poultry Flocks

Composite adipose (fat) tissue samples from all flocks are tested using a comprehensive analytical screen. When testing turkey and poultry flocks, the following procedures should be followed:

- a. Adipose (fat) tissue samples should be taken from six (6) turkey or poultry following the procedure shown in table 4 of the Appendix.
- b. All tissue samples should be taken from live births in the field 2 to 5 days before transport to the processing plant. No flock should be sent to the processing plant before the results of the analytical screens for chemical residues are reported. Also, tissue samples should not be taken more than 5 days prior to processing to minimize the risk of contamination of the flock after testing.

- c. Composite samples from up to three individual flocks may be pooled for analysis if the analytical procedures enable a limit of detectability that is up to three times greater than the limits that exist using standard analytical methods.

3. Testing of All Ingredients

All feed ingredients except corn, soybean meal, vitamins, and minerals should be carefully evaluated. This generally includes animal byproduct meals, fish meals, bakery byproduct meals, special premixes and fats and oils. The evaluation should consider the known history of contamination of the materials both locally and nationally and achieve a thorough knowledge of the suppliers' operations, history of contamination problems, and quality control procedures.

Historically, feed grade fats and oils have been responsible for the majority of the chemical residue contamination problems in turkey, poultry and livestock. Therefore, they represent a feed ingredient of primary concern. Under this proposed program, it is recommended that every fat supplier used by the turkey and poultry operation be requested to test all fat products and provide results before, or at the time of, delivery. Most rendering companies participate in chemical residue screening programs and readily comply with the request. Their costs for pesticide/hydrocarbon analyses is generally reasonable since they can test one sample from a tank that contains two to ten truckloads of finished product.

It is known that, historically, blended fat products have had a higher incidence of chemical residue contamination than species-specific fats such as beef tallow or hog grease. Therefore, it is particularly important to establish a comprehensive screening program with the suppliers of blended fats and oils.

If fat suppliers do not participate in a chemical residue screening program, the turkey and poultry operation should seek alternative sources of supply or establish their own screening program for this feed ingredient. Samples may be taken at time of delivery and analyzed within 24 hours. Unfortunately, even with rapid laboratory turnaround time, results of high levels of chlorinated pesticides/hydrocarbons reported 24 hours later could result in the need for voluntary recovery of contaminated feed. The more reasonable approach to this problem is the establishment of an in-house screening program for fats and oils utilizing alternating fat storage tanks and testing a composite sample of several shipments prior to use of the material in feed.

If an evaluation of other feed ingredients and feed ingredient suppliers indicates that there is a reason for concern regarding chemical residues, similar steps should be taken. These would include a request for supplier testing prior to shipment or the establishment of an inhouse sampling and testing program.

The implementation of a comprehensive program to test specific feed ingredients with histories of chemical residue contamination complement the testing of turkey and poultry flocks and substantially reduce the risk of contamination of turkey and poultry tissues.

4. The Quality of the Laboratory Analysis

The quality of the laboratory analytical procedures and technical support used to screen for the chemical residues should be carefully evaluated. The important parameters for this evaluation should include the following:

- a. Comprehensive nature of the analytical screen
- b. The limits of detectability
- c. The quality assurance/quality control procedures employed
- d. The timeliness of the analytical results
- e. The availability of qualified technical support.

A detailed discussion of the important considerations presented here is found in pages 22 to 25, Section III-C, 6 of this document. It is firmly believed that the HACCP-based program proposed here represents the optimum combination of the greatest possible risk reduction at the lowest possible cost that can be achieved with the establishment of a program for this purpose.

Appendix

**TABLE I
SUMMARY OF TOLERANCES FOR CHLORINATED PESTICIDES
AND OTHER COMPOUNDS**

PESTICIDE, ISOMER, METABOLITE, OR INDUSTRIAL CHEMICAL	TOLERANCE or ACTION LEVEL	NOTES
BHC, alpha isomer	0.3ppm	Action level ⁽¹⁾
BHC, beta isomer	0.3ppm	Action level
BHC, delta isomer	0.3ppm	Action level
Lindane, (which is the gamma isomer of BHC).	4.0 ppm	Action level
p,p'-DDT	5.0 ppm ⁽²⁾	
p,p'-DDD	5.0 ppm ⁽²⁾	
p,p'-DDE	5.0 ppm ⁽²⁾	
o,p'-DDT	5.0 ppm ⁽²⁾	
o,p'-DDD	5.0 ppm ⁽²⁾	
o,p'-DDE	5.0 ppm ⁽²⁾	
Aldrin	0.3ppm	Action level ⁽³⁾
Dieldrin	0.3ppm	Action level ⁽³⁾
Endrin	0.3ppm	Action level
Endrin aldehyde	zero tolerance ⁽⁴⁾	a metabolite of Endrin
Endrin ketone	zero tolerance ⁽⁴⁾	a metabolite of Endrin
Hexachlorobenzene (HCB)	0.5ppm	Action level
Heptachlor	0.2ppm ⁽⁵⁾	Action level
Heptachlor Epoxide	0.2ppm ⁽⁵⁾	Action level
Toxaphene	7.0 ppm	Action level
Strobane	zero tolerance ⁽⁴⁾	

PESTICIDE, ISOMER, METABOLITE, OR INDUSTRIAL CHEMICAL	TOLERANCE or ACTION LEVEL	NOTES
Chlordane, alpha isomer ⁽⁶⁾	0.3ppm	

Chlordane, gamma isomer ⁽⁶⁾	0.3ppm	
Chlordene, alpha isomer ⁽⁶⁾	0.3ppm	
Chlordene, gamma isomer ⁽⁶⁾	0.3ppm	
Cis-Nonachlor ⁽⁷⁾	zero tolerance ⁽⁴⁾	
trans-Nonachlor ⁽⁷⁾	zero tolerance ⁽⁴⁾	
Oxychlordane ⁽⁷⁾	zero tolerance ⁽⁴⁾	
Methoxychlor	3.0 ppm	Action level
Mirex	zero tolerance ⁽⁴⁾	new for 1992 ⁽⁸⁾
Perthane	zero tolerance ⁽⁴⁾	
PCNB (Pentachloronitrobenzene)	zero tolerance ⁽⁴⁾	
Chlorbenside	zero tolerance ⁽⁴⁾	
Chlorothalonil	zero tolerance ⁽⁴⁾	
Chlorpyrifos	0.1ppm ⁽⁹⁾	
Chlopyrifos Oxygen Analog (metabolite of Chlorpyrifos)	0.5ppm ⁽⁹⁾	
Methyl Chlorpyrifos and metabolite	0.5ppm ⁽¹⁰⁾	
Carbophenothion (Ethyl Trithion)	zero tolerance ⁽⁴⁾	
Ethion	0.2ppm	
Parathion	zero tolerance ⁽⁴⁾	new for 1992 ⁽¹¹⁾
Ronnel	0.01ppm	
Endosulfan I and metabolite	zero tolerance ⁽⁴⁾	
Fonophos (Dyphonate)	zero tolerance ⁽⁴⁾	
PCB's (polychlorinated biphenyls)	3.0 ppm	Action level

FOOTNOTES

- (1) Action level is an administratively established level set by FDA for purposes of regulatory action where an official tolerance established through the Code of Federal Regulations (CFR) is deemed to be economically feasible for a given commodity.**
- (2) The tolerance for these isomers is applied on a Total DDT basis which is the sum of all of the six isomers and metabolites listed.**
- (3) Aldrin and Dieldrin have been enforced in the past as 0.3ppm action level for the combined concentrations of these two compounds.**
- (4) A zero tolerance (or no tolerance) is the usual enforcement level for FDA where no official tolerance has been set and no action level exists.**
- (5) Heptachlor and Heptachlor Epoxide are enforced as 0.2ppm action level for the combined concentrations of these two compounds.**
- (6) The tolerance for Chlordane is 0.3ppm for the sum of all of these isomers and may also be subject to summing with levels of metabolites such as those in footnote seven (which see).**
- (7) cis-Nonachlor and trans-Nonachlor are constituents of the technical formulation of Chlordane, as is Heptachlor. Oxychlordane is a metabolite of Chlordane and Heptachlor Epoxide is a metabolite of Heptachlor which is a constituent of Technical Chlordane. All of these compounds can complicate the calculation of total Chlordane for regulatory purposes.**
- (8) Mirex has been regulated based on an action level of 0.10ppm in the past. However, for 1992 the action level has been dropped and a zero tolerance has been adopted.**
- (9) Chlorpyrifos and its metabolite Chlorpyrifos Oxygen Analog are enforced as 0.1ppm action level for the combined concentrations of these two compounds.**
- (10) Methyl Chlorpyrifos and its metabolite are enforced as 0.5ppm action level for the combined concentrations of these two compounds. Due to the unavailability of standards for the metabolite, the only means currently available for the confirmation of the presence of the metabolite is through Gas Chromatography/Mass Spectrometric analysis.**
- (11) Parathion has been regulated on an action level in the past but recently a zero tolerance has been adopted.**

TABLE II

**LIST OF CHLORINATED HYDROCARBONS INCLUDED
IN USDA LABORATORY ACCREDITATION**

Chlorinated Pesticides

Alpha-BHC	Dieldrin	Endrin
Lindane	Methoxychlor	HCB
Mirex	p,p'-DDT	p,p'-DDE
p,p'-TDE	Heptachlor Epoxide	

Other Chlorinated Hydrocarbons

Arochlor 1254
Arochlor 1260

**TABLE III - SUMMARY OF ORGANOCHLORINE/ORGANOPHOSPHATE
PESTICIDES, ISOMERS AND METABOLITES AND OTHER
CHLORINATED HYDROCARBONS INCLUDED IN DIVERSIFIED
LABORATORIES' PESTICIDE/CHLORINATED HYDROCARBON SCREEN**

Pesticide Screen

47 compounds with positive identification of chemical structure

alpha-BHC
beta-BHC
delta-BHC
gamma-BHC (Lindane)
BHC (Total)
p,p'-DDT
p,p'-DDD
p,p'-DDE
o,p'-DDT
o,p'-DDD
o,p'-DDE
DDT (Total)
Aldrin
Dieldrin
Hexachlorobenzene
Captan
Endrin
Endrin Aldehyde
Endrin Ketone
Heptachlor
Heptachlor Epoxide
Toxaphene
Strobane
Methoxychlor
o,p'-Methoxychlor
Mirex
Perthane
PCNB
Chlorbenside
Chlorthalonil
Chlorpyrifos
Methyl Chlorpyrifos
Permethrin
Chlorpyrifos Methyl Oxygen Analog
Carbophenothion
Ethion
Parathion

Ronnel
Endosulfan I
Endosulfan II
Endosulfan Sulfate
Fonophos (Dyphonate)
alpha-chlordane
alpha-chlordene
cis-nonachlor
gamma-chlordane
gamma-chlordene
trans-nonachlor
Oxychlordane
Chlordane (Total)

**17 compounds with positive identification as chlorinated compounds
and tentative identification of chemical class/chemical structure**

Phenoxy phenyl chlorinated
Chlorinated hydroquinone Isomer #1
Multi chlorinated aromatic hydrocarbon #1
Phenoxy phenyl chlorinated
Chlorinated hydroquinone Isomer #2
Multi chlorinated aromatic hydrocarbon #2
Polychlorinated benzodioxathiepin
Chlorinated hydroquinone Isomer #3
Chlorinated hydrocarbon #3
Chlorinated hydrocarbon derivative #1
Chlorinated hydroquinone Isomer #4
Chlorinated aromatic hydrocarbon #2
Chlorinated hydroquinone Isomer #5
Chlorinated alliphitic hydrocarbon Isomer #1
Chlorinated alliphitic hydrocarbon Isomer #2
Chlorinated alliphitic hydrocarbon Isomer #3
Chlorinated orgnophosphate isomer

Polychlorinated Biphenyls Screen

Arochlor 1221	Arochlor 1248	Arochlor 1262
Arochlor 1232	Arochlor 1254	Arochlor 1268
Arochlor 1242	Arochlor 1260	

TABLE IV -

**INSTRUCTIONS FOR SAMPLING, PACKAGING AND SHIPPING
ADIPOSE TISSUES FOR PESTICIDE/PCB SCREEN**

Sampling

IMPORTANT - SAMPLING IS THE STEP WHERE EXTERNAL CONTAMINATION OF THE TISSUES IS MOST LIKELY TO OCCUR. THEREFORE, PLEASE FOLLOW THE INSTRUCTIONS CAREFULLY.

1. At random select six (6) birds from the same flock.
2. Transfer the carcasses to a clean area where no contamination from dust, dirt, pesticides, herbicides or other chemicals can take place.
3. Wash hands and knife or other equipment thoroughly before removing tissue.
4. Remove one piece of adipose (fat) tissue from the abdominal cavity of each bird.
5. The sample of fat tissue from each bird should be approximately the diameter of a silver dollar and ¼ inch in thickness or a size that would fit on a tablespoon (approximately ½ ounce or 14 grams).
6. Place the piece of fat tissue from each bird on a separate 6 to 8 inch sheet of clean aluminum foil torn off from a standard roll of aluminum foil.

Packaging

IMPORTANT - PACKAGING IS THE MOST CRITICAL STEP TO AVOID LEAKAGE, PLEASE FOLLOW INSTRUCTIONS CAREFULLY.

1. Wrap each individual tissue sample in the 6 to 8 inch aluminum foil sheet by bringing the two opposite edges together, folding the two edges over approximately ½ inch and creasing it along the entire fold with thumb and forefinger. Repeat a series of ½ inch folding and creasing until the foil is wrapped tightly against the tissue.
2. Take the remaining two opposite ends and fold and crease these ends until they are wrapped tightly against the tissue sample. This should help to insure no leakage of fat.
3. Place each foil-wrapped sample into an individual plastic bag (e.g., "baggies"). Be sure to remove excess air from the bag and then secure tightly with a twist tie.
4. Wrap each of the six plastic bags in two or three layers of paper toweling and place all six in a single "master" bag. Be sure to remove excess air from the bag and then secure tightly with a twist tie.

Shipping

IMPORTANT: THE U.S. POSTAL SERVICE AND OTHER COURIERS WILL NOT DELIVER PARCELS WHICH ARE IMPROPERLY PACKAGED. IT IS EXTREMELY IMPORTANT TO FOLLOW ALL INSTRUCTIONS COMPLETELY AND PRECISELY IN ORDER TO INSURE THAT THE U.S. POSTAL SERVICE OR OTHER COURIERS WILL DELIVER THE PARCEL.

1. Enter appropriate flock identification on the white label (provided by Diversified Labs) and secure to master bag.
2. Place master bag in plastic liner (provided by Diversified Labs) fold end of plastic liner one or more times and secure with staples or tape. Then place secured plastic liner into Diversified Laboratories' shipping envelope.
3. Complete the tissue analysis request form (provided by Diversified Labs) for pesticide/PCB screen. Be sure to use a ball point pen and press firmly. It is particularly important to include the growers name and the flock identification. Also, be sure to check the block for pesticide/PCB analysis.
4. Enclose first copy of the tissue analysis request form (white copy) in a separate plastic bag or liner to avoid smearing from possible fat leakage and place in the shipping envelope. Place no more than the six tissues from a single flock in one shipping envelope. Use additional envelopes for more than one flock. Several shipping envelopes can be inserted into an overnight courier package. Seal and send by overnight courier service, overnight mail, or regular mail to:
Diversified Laboratories, Inc.
3810 Concorde Parkway
Chantilly, VA 20151
5. Retain yellow copy of tissue analysis request form for your records or send to central office if required.

