Investigation and assessment of pesticide residues of livestock products in Taiwan

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Abstract

The Maxiumu Residue Limits(MRLs) for pesticide in livestock products are set to protect consumers' health and ensure fair practices of agricultural products.To complete the related assessment procedure in Taiwan, the aim of this study include: 1. Sampling and analyzing the products in order to get the pesticide residue information in Taiwan market. 2. In hope to harmonize to international standards and recommend the appropriate regulation criteria, the assessment procedures were set based on international guidelines. 3. To enhance the risk assessment and safety management, the scientific study and assessment of the MRL of livestock products applicable in Taiwan will be carried out. To begin with, we had collected livestock product items (n=204) from markets for analysis. At least 122 pesticides were examined on products with QuEChERS method for pretreatment and followed with LC/MS/MS and GC/MS/MS by multiresidue analytical technique. The analytical results revealed 0.02 ppm fipronil residue in 1 domestic pork item, and the detected values of other 203 items were all below the limit of quantitation(LOQ). Eventually, we completed scientific assessment reports of pesticide residue in livestock products, the study items included (1) toxicity information, (2) residue definition, (3) residue analytical methods, (4) exposure routes, (5) feedstuff diet proportions of livestock animals, (6) dietary burden calculation, (7) feeding studies, (8) maximum residue level, (9) dietary risk assessment (10) information regarding the legal use and MRL of the chemical in Taiwan and other countries. In sum, residues risk assessments of livestock products and the evaluation of the MRLs setting from guidelines are the significant progress in management and the analyzing results provide the evidence indicate that reveal the low pesticide residue in livestock products in Taiwan, but continuous efforts to maintain regular risk assessment is necessary.

1.Introduction

The Maxiumu Residue Limits(MRLs) for pesticide in livestock products are set to protect consumers' health and ensure fair practices of agricultural products. Standards of livestock products need to be set because animals may be exposed to pesticides through feed or environmental exposure during their production(Fig. 1), especially pesticides with bioaccumulative properties such as high environmental stability, or high fat solubility, like organochlorine agents (OCPs) which have long been concerned by international public Residue pesticides could pose a potential health risk to consumer. Given that the current food security issue is of concern to the general public, the allowable standard for agricultural products is closely related to public consumer without risk of harm to health, in this study we set the assessment procedures to assess related MRLs to enhance the risk assessment and management. Considering that in the past we had not conducted large-scale planning for investigating livestock products residue pesticides in Taiwan, this study intends to be used as an example to establish relevant protocol and to get the pesticide residue information in Taiwan.

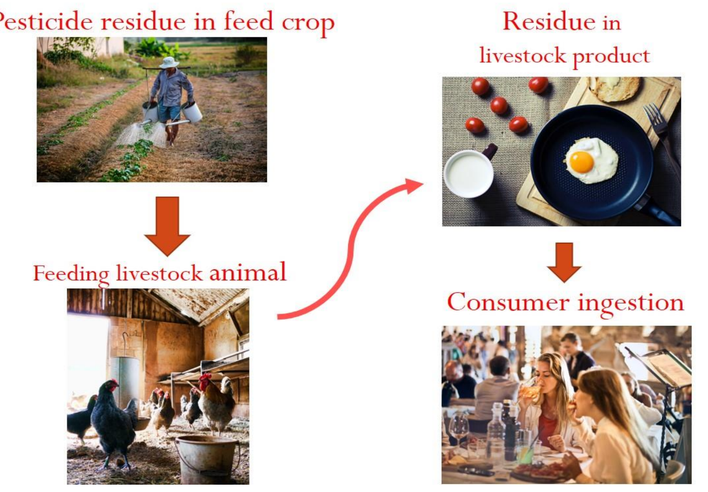


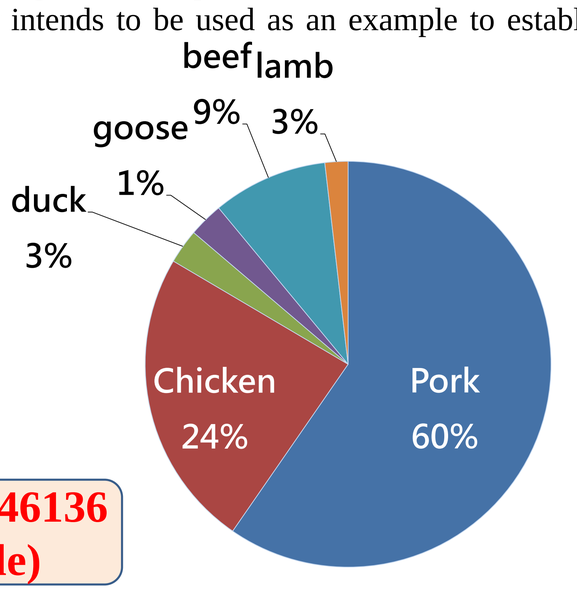
Fig.1. Pesticide residue of livestock product process

2.Materials and Methods

2.1. Sampling and analyzing of animal agricultural products.

2.1.1 To sample logically and representatively, the selection process we considered the actual intake of agricultural products by the 「Food Consumption Database」statistical data in Taiwan (Fig. 2),. Finally we collected 204 livestock product items for analysis.

2.1.2 The analytical methods applied to determined pesticide residues we conducted QuEChERS method for pretreatment. Then we examined on products for at least 122 pesticides with LC/MS/MS and GC/MS/MS by multiresidue analytical technique.



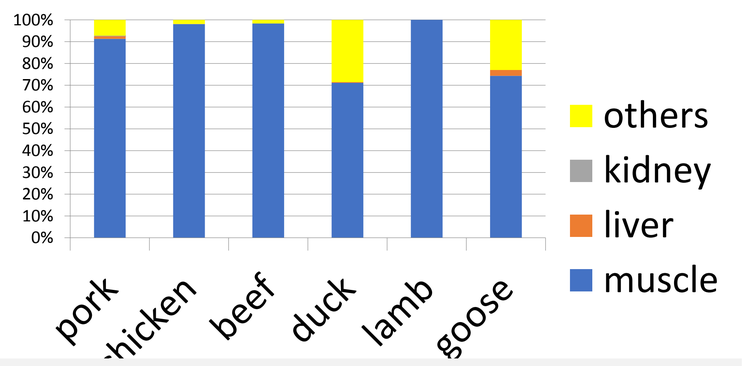


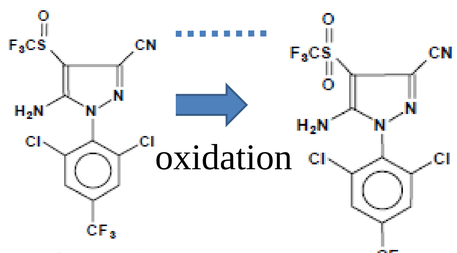
Fig. 2. Food Consumption data of livestock product in Taiwan(represent from 19-65 year public group)

2.2. Assessment of MRL for pesticide residue of livestock products

We took the example of evaluating procedures of the MRL of fiponil in eggs(Fig. 3).

1.Residue Definition
Identify of the pesticide and its metabolites and data on fat-solubility

Livestock (Hens) Metabolism Test = **Fipronil+MB46136 (fat-soluble)**



fipronil — MB46136 (major residue!)

2.Residue in feed
Find the levels of residue as HRs or STMRs values in the raw agricultural commodity (RAC) from supervised trials.

3. Dietary burden Calculations
Determine the residue contribution from each feed commodity and calculate the total potential dietary intake for each livestock animal on a feedstuff dry matter basis.

Commodity (poultry)	Residue level (dry basis) (mg/kg)	diet (%)	Residue contribution
		TW	
Corn, field grain	0.0057	70	0.004
Rice	0.0068	30	0.002
Dietary burden		100	0.006

Fig. 3. Assessment of MRL for pesticide residue of livestock products procedures (JMPR, 2001)

Residue analytical method
For residue analysis with MRL enforcement purposes focused on those 'analytes' which can be quantified by multiresidue analytical technique.

4. Livestock feeding studies
Find the levels of pesticide residue likely to occur in animal tissues from repeated daily dosing of the animals

Doses(hen)	0.01 ppm
Fipronil and MB46136 residues (mg/kg) (LOQ=0.01 mg/kg)	
muscle	<0.01
egg	0.013
liver	<0.01
Sikn and muscle	0.014

5. Integrate dietary burden and feeding studies
Estimate HRs for livestock product by interpolating or applying the transfer factor.

Transfer factor.
A (Dietary Burden):B (Dosage of Feeding study)= C (Residue level for MRL calculation):D(Residue result of Feeding study)

HR=0.008 ppm in poultry egg

6. MRLs in animal commodities
Considered from calculated HRs for livestock products and MRLs set from other countries.

7. Dietary risk assessment
long-term(TMDIs and expressed as percentage of the ADI and short-term (single-day consumption data for the 97.5th percentile compared to ARfD

Toxicological assessment

3.Results and discussion

The analytical results (Fig. 4) revealed 0.02 ppm fipronil residue in 1 domestic pork item. It is hard to distinguish the residual source. Although Fipronil is a broad-spectrum insecticide and used as pesticide, veterinary drugs and environmental agent, it cannot be applied directly to livestock animals legally in Taiwan. The outbreak of egg contaminated with fipronil in countries including Taiwan around the world in 2017 was due to illegal use, but still revealed that fipronil does have residual risk potentially and may result from its high fat-soluble characteristic. In general the results provided the evidence that reveal the low pesticide residue in livestock products in Taiwan, but because of the sampling numbers was limited, we need continuous investment to refine risk assessment.

We completed scientific assessment and eventually recommended more than 800 standards of pesticide residue in livestock products. In this case of example of evaluating of fiponil in eggs, we recommend 0.01 ppm as MRL. Residues risk assessments of livestock products and the evaluation of the MRLs setting from guidelines are the significant progress in management. The results of the study, regardless of the sampling and recommended MRL, are the basis for the decision of the competent authority. In the future, we will collect more information like feedstuff data locally to refine assessment procedures.

Item	Swine meat	Swine edible offal	Cattle meat	Goat meat	Poultry meat*	Poultry edible offal*	Fish*	Shrimp*
Sample numbers	28	43	26	10	48	19	20	10
Detection of residue pesticide and values	1/ 0.02 ppm	0	0	0	0	0	0	0
Pesticide name	fipronil							

*poultry items included chicken, duck and goose

*fish items included tilapia and milkfish

*shrimp items included tiger prawn and white shrimp

Fig. 4. Sampling item and analytical results

References:
1.FAO (Food and Agriculture Organization of the United Nations), 2016. FAO Manual on the Submission and Evaluation of Pesticide Residues Data for the Estimation of Maximum Residue Levels in Food and Feed, 3rd edition, Rome, Plant Production and Protection 225: 81-121.
2.OECD (Organization for Economic Co-operation and Development), 2013. Guidance documents on residues in livestock, Series on pesticide No 73, ENV/JM/MONO(2013)8, p. 77.