国家食品安全风险评估中心高层次人才队伍建设523项目

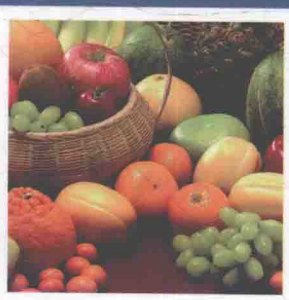
The Fifth China Total Diet Study

第五次中国总膳食研究

吴永宁 赵云峰 李敬光 主编

编辑推荐




科学出版社

国家食品安全风险评估中心高层次人才队伍建设523项目

第五次中国总膳食研究

The Fifth China Total Diet Study

吴永宁　赵云峰　李敬光　主编

科学出版社

北京

内 容 简 介

在风险评估框架中，总膳食研究是世界卫生组织极力推荐的暴露评估技术，用于一个国家或一个地区代表性人群膳食污染物暴露量和营养素摄入量的评价。

我国已成功开展了五次总膳食研究。第五次中国总膳食研究于2009年开始，2015年完成，包括脂肪酸、营养元素、污染元素、农药残留、兽药残留、真菌毒素、持久性有机污染物、食品加工过程污染物等项目检测与膳食摄入量评估。本书按照总膳食研究成果整体结集出版的模式，参照《第四次中国总膳食研究》体例，全面总结了第五次中国总膳食研究的最新成果。根据更新的食物消费量和最近的即食食品污染数据，全面评价我国居民的多种污染物膳食暴露情况，并与历次总膳食研究结果进行比较，了解各类污染物的变化趋势，同时，本次增加氯丙醇酯、邻苯二甲酸酯、三嗪类农药残留等膳食暴露评估资料。本书中的研究结果已在食品安全国家标准：食品中污染物限量标准（GB 2762—2017）和食品中真菌毒素限量标准（GB 2761—2017）修订中得到了应用。

本书数据充分，结论可靠，是定期发布的我国居民膳食污染物暴露量的结果，对食品安全风险评估工作具有重要参考价值，是国内外相关技术机构及专业技术人员重要的参考工具。

图书在版编目（CIP）数据

第五次中国总膳食研究 / 吴永宁，赵云峰，李敬光主编. —北京：科学出版社，2018. 1

ISBN 978-7-03-050963-5

Ⅰ. ①第… Ⅱ. ①吴… ②赵… ③李… Ⅲ. ①居民 - 膳食营养 - 研究 - 中国 Ⅳ. ① R151. 4

中国版本图书馆 CIP 数据核字（2016）第 298489 号

责任编辑：罗 静 岳漫宇 / 责任校对：郑金红

责任印制：肖 兴 / 封面设计：刘新新

科学出版社出版

北京东黄城根北街 16 号

邮政编码：100717

http://www.sciencep.com

中国科学院印刷厂印刷

科学出版社发行 各地新华书店经销

*

2018 年 1 月第 一 版 开本：787 × 1092 1/16

2018 年 1 月第一次印刷 印张：41 1/2 彩插：12

字数：984 000

定价：298.00 元

（如有印装质量问题，我社负责调换）

编者名单

主　　编　吴永宁　赵云峰　李敬光

执行主编　李筱薇　苗　虹　周　爽　吕　冰

编写人员

第一章　吕　冰　李筱薇　吴永宁

第二章　吴永宁　刘　沛　李筱薇　吕　冰

第三章　杨　杰　方从容　赵云峰

第四章　李筱薇　刘丽萍　岳　兵

第五章　苗　虹　陈达炜　吕　冰　杨　欣　朱　盼

第六章　张　晶　邵　兵

第七章　苗　虹　陈达炜　高　洁　杨　欣　苗宏键

第八章　李敬光　张　磊　施致雄　王雨昕　赵云峰

第九章　周　爽　王　丹　张　烁

第十章　崔　霞　苗　虹　赵云峰

项目参加人员（按姓氏比划排序）

王　萍　田美娜　付鹏钰　白光大　兰　真

刘长青　许丽丽　孙　静　李秋娟　李绥晶

李梓民　吴　凡　邹淑荣　宋壮志　张　辉

张书芳　陈子慧　林　熙　易传祝　周　妍

周永林　赵　鹏　赵　耀　胡国良　钟文玲

闻　胜　秦爱萍　袁秀娟　贾海先　徐增康

黄礼春　黄丽娜　常　锋　崔春霞　章荣华

蒋玉艳　韩澄华　舒学军　颜　玲　戴　月

前　言

总膳食研究是世界卫生组织极力推荐的风险评估框架中的暴露评估技术，由于其经济、高效因而在发达国家（美国、加拿大、英国、澳大利亚、新西兰、法国等）成功开展，并将有关结果整体结集发布。2009 年《中华人民共和国食品安全法》的出台使得国家食品安全风险评估工作成为国家制度。中国总膳食研究作为风险评估技术中最重要的一环，成为其中暴露评估的重要工作内容。中国以陈君石院士为首从 1990 年开始实施总膳食研究计划，结果在 *J AOAC INT* 杂志发表并获得国际认可。经过 20 年的经验摸索和积累，已经形成了一套具有中国膳食文化特色的，切实可行的中国总膳食研究方法，并成为发展中国家成功独立开展总膳食研究的楷模。中国总膳食研究已成功开展了 5 次（1990 年、1992 年、2000 年、2007 年、2009~2013 年），其中第四次中国总膳食研究获得科技部国家科学技术学术著作出版基金的资助，并作为“十二五”国家重点图书进行结集整体出版。为使中国总膳食研究成果能够连续、系统地展示，本书将第五次中国总膳食研究内容进行整理，继续采用专著方式进行出版。

本书对第五次中国总膳食研究（2009~2013 年）进行了全面的总结，更新了我国食物消费量、食物加工因子、多种污染物的含量及摄入量数据。在有关暴露量估计方面从微量元素、重金属元素及其形态、农药残留、兽药残留、持久性有机污染物及其他新型污染物等当前食品安全关注热点的各个方面全方位阐述我国居民重点食物的污染状况，结合食物消费量数据全面评价我国居民的多种化学污染物的膳食暴露情况，为系统而准确地评估我国居民的膳食风险提供了科学的依据。其结构体系特点鲜明，结合食品安全风险评估原理的主要步骤与关键技术展开，理论联系实际，以实际膳食样品中所得到的暴露评估数据逐级进行详细解说和论述。本工作得到十三五国家重点研发计划食品安全关键技术研发专项“食品污染物暴露组解析与总膳食研究”（2017YFC1600500）、国家自然科学基金重点项目“新型含卤污染物的环境暴露组与健康效应的毒理学机制”（21537001）和 973 项目“食品加工过程安全性评价及危害物风险评估”（2012CB720804）课题联合资助。希望能够对于系统开展中国的暴露评估提供理论指导及实用价值。

借助于有中国特色及与国际暴露评估接轨的总膳食研究，我国居民的食物消费量数据及重金属元素、元素形态和丙烯酰胺的暴露评估数据已经成为全球的食品安全限量卫生标准制定和暴露评估的重要依据。望借助此书的出版，进一步在全国范围内提倡和规范以总膳食研究为方法学的暴露评估技术，并能持续发展中国总膳食研究并按这一方式出版专著，使得中国的暴露评估数据得以定期公开发布，为中国食品安全事业略尽绵薄之力！

吴永宁

2017 年 10 月 1 日

Preface

Total diet study is a dietary exposure assessment technique strongly recommended in the WHO Human Health Risk Assessment Toolkit. Because of its economy and efficiency, this technique has been successfully conducted in developed countries including the United States, Canada, U.K., Australia, New Zealand, and France, and findings in connection with this technique have been collected and published. In 2009, China enacted its *Food Safety Law*, which made food safety risk assessment a basic component of the country's food safety work. Performing a total diet study for China, which functions as the most important dietary exposure assessment technique, is a critical part of exposure assessment. China first total diet study started in 1990, led by Chen Junshi, Academician, Chinese Academy of Engineering, and its results were published in the *Journal of AOAC International* and won international recognition. Through 20 years of empirical exploration and accumulation, China has developed a feasible total diet research methodology with the characteristics of Chinese culinary culture and become a role model for developing countries in independently undertaking total diet research. China has conducted five total diet studies (1990, 1992, 2000, 2007, and 2009~2013). Fourth China total diet study has been founded by the academic publication fund from Ministry of Science and Technology of the People's Republic of China, as one of the "National 12th Five-Year key book" collection. In order to systematically release the data of China total diet, the fifth China total diet study will be continuously published in monograph.

This book presents a comprehensive summary of the fifth China total diet study (2009~2013), updating China food consumption data, food processing factors, organic pollutant levels, and exposure data. It offers a full review and assessment of the pollution of China main foods in terms of trace elements, heavy metals and their forms, pesticide residues, veterinary drug residues, persistent organic pollutants and other emerging pollutants, and presents comprehensive evaluation of dietary exposure of Chinese residents to various chemical pollutants on the basis of food consumption data. Featuring a unique structure, this book unfolds around the main steps and key techniques of food safety risk assessment and combines theory and practice, providing detailed explanations to and commentaries on the exposure data obtained from food samples. This work is supported by joint grants from the National key R&D Program of China-Charactering Exposome of Food contamination and Chinese Total Diet Study (2017YFC1600500), the National Natural

Science Foundation of China Emerging Halogenated Pollutants: Toxicological Mechanism of Action Linkage to Environmental Exposome and Health Effect (21537001), and National Program on Key Basic Research Project (973 Program)-Risk Assessment and Safety Evaluation of Hazard Formed during Food Processing (2012CB720804). It is hoped that this book will prove valuable in both theoretical guidance and practice for performing systematical dietary exposure assessment in China.

China food consumption data and exposure assessment data about heavy metals, element speciation, and acrylamide, collected from total diet studies with Chinese characteristics and in line with international dietary exposure assessment practices, have become an important basis for international food safety limit standard formulation and exposure assessment. It is hoped that the publication of this book will promote and standardize the development of total diet research methodology-based exposure assessment techniques in China and initiate the regular publication of China dietary exposure assessment data, thereby contributing to China food safety.

Wu Yongning
October 1, 2017

目　录

Contents

概　要

Summary

总膳食研究（TDS）是研究和估计某一人群通过烹调加工的、可食状态的代表性膳食（包括饮水）摄入的各种膳食化学成分（污染物、营养素）的方法，总膳食研究旨在衡量一个国家不同性别/年龄组每种化学品的平均摄入量，这些数据对评估特定化学品是否对健康构成风险是十分必要的。事实上，总膳食研究是让风险管理者在有限的资源集中在对公共卫生构成极大风险的化学物质的一项优先手段。本书旨在发布第五次中国总膳食研究结果。

第五次中国总膳食研究的主要研究内容及研究结果如下。

1. 中国总膳食研究工作方法

阐述了总膳食研究中关于调查点的选择、确定、具体膳食调查方法；食物样品聚类、采样单的形成、食物样品准备和运输等具体实验环节。

2. 食物消费量数据

在本次总膳食研究膳食调查的基础上，发布了中国性别/年龄组及20个省（直辖市、自治区）的食物消费量数据。

3. 第五次中国总膳食研究脂肪酸的膳食摄入量评估

我国居民膳食各类脂肪酸摄入量分别为：总脂肪酸71.88 g/d，相当于646.96 kcal/d（29.79% E[①]）；饱和脂

Total diet study (TDS) is considered as a most efficient and effective method to evaluate the dietary intakes of certain chemical substances (e.g. contaminates and nutrients) through the ready to eat diet including water for a group of populations. Total diet studies are designed to measure the average amount of each chemical ingested by different age/sex groups living in a country. These data are necessary to assess whether or not specific chemicals pose a risk to health. In fact, total diet studies can be used as a priority-setting tool to enable risk managers to focus their limited resources on those chemicals, both contaminants and nutrients, that pose the greatest risks to public health. This book aims to release the results of 5th China total diet Study.

The main description of methods and results of 5th China total diet study were as following:

1. The Establishment of Total Diet Study Procedures

In the first part of the study, the detailed procedures were explained including the principle of selecting the investigated place, dietary survey method, the aggregation of the food samples, the preparation and the transformation of the diet samples.

2. The Food Consumption Data

Based on the food consumption survey, this book released the average food consumption of China residents, the food consumption of different sex/age groups and average food consumption of 20 provinces.

3. The Dietary Intakes of Fatty Acids of 5th China TDS

The dietary intakes of all kinds of fatty acids were: total fatty acid 71.88 g/d, equivalent to 646.96 kcal/d (29.79%

①供能比，pecentage of energy

肪酸 19.24 g/d，相当于 173.13 kcal/d（7.97% E）；单不饱和脂肪酸 27.02 g/d，相当于 243.21 kcal/d（11.20% E）；多不饱和脂肪酸 25.41 g/d、相当于 228.68 kcal/d（10.53% E）；ω-6 脂肪酸 21.98 g/d，相当于 197.81 kcal/d（9.11% E）；ω-3 脂肪酸 3.42 g/d，相当于 30.85 kcal/d（1.42% E）；反式脂肪酸 0.57 g/d，相当于 5.11 kcal/d（0.24% E）。我国总膳食研究中总脂肪酸的主要来源为肉类和蔬菜类；饱和脂肪酸的主要来源为肉类，蔬菜类和谷类次之；单不饱和脂肪酸的主要来源为肉类和蔬菜类；多不饱和脂肪酸的主要来源为蔬菜类，肉类、谷类和豆类次之；反式脂肪酸的主要来源为蔬菜类和肉类。蔬菜类和谷类样品之所以含有较高的脂肪酸，其主要原因是来自蔬菜烹饪中添加的烹调用油。

4. 第五次中国总膳食研究元素的膳食摄入量评估

（1）营养元素

我国居民膳食营养元素摄入量分别为：钠 5302 mg/d、钾 2384 mg/d、钙 492 mg/d、镁 345 mg/d、磷 1190 mg/d、锰 6.9 mg/d、铁 25.6 mg/d、锌 11.9 mg/d、铬 0.33 mg/d、铜 1.9 mg/d、硒 156 μg/d 和钼 232 μg/d。

（2）污染元素

我国居民重金属、有害元素及其形态的膳食暴露量分别为：铅 35.1 μg/d、镉 32.7 μg/d、总汞 4.5 μg/d、甲基汞 0.6 μg/d、总砷 118 μg/d、无机砷 27.7 μg/d、铝 13.4 mg/d。我国居民 10 个性别 / 年龄组的铅暴露量为 20.2~39.7 μg/d；镉暴露量为 10.9~22.6 μg/d。重金属铅和镉的膳食暴露水平均应该重点关注 2~7 岁组及 8~12 岁组的少年儿童。

E)；saturated fatty acids 19.24 g/d，equivalent to 173.13 kcal/d (7.97% E)；monounsaturated fatty acids 27.02 g/d，equivalent to 243.21 kcal/d (11.20% E)；polyunsaturated fatty acids 25.41 g/d，equivalent to 228.68 kcal/d (10.53% E)；ω-6 fatty acid 21.98 g/d，equivalent to 197.81 kcal/d (9.11% E)；ω-3 fatty acids 3.42 g/d，equivalent to 30.85 kcal/d (1.42% E)；trans-fatty acids 0.57 g/d，equivalent to 5.11 kcal/d (0.24% E). The major foods contributing to dietary total fatty acid were meats and vegetables; the major foods contributing to dietary saturated fatty acids were meats, and followed by vegetables and cereals; the major foods contributing to dietary monounsaturated fatty acids were meats and vegetables; the major foods contributing to dietary polyunsaturated fatty acids were vegetables, and followed by meats, cereals, and legumes; the major foods contributing to dietary trans-fatty acids were vegetables and meats. The high level of fatty acids in vegetables and cereals being mainly attributable to the cooking oil they were cooked with.

4. The Dietary Intakes of Micro and Trace Elements of 5th China TDS

(1) Nutrient Elements

The dietary intakes of nutrient elements were: sodium 5302 mg/d, potassium 2384 mg/d, calcium 492 mg/d, magnesium 345 mg/d, phosphorus 1190 mg/d, manganese 6.9 mg/d, iron 25.6 mg/d, zinc 11.9 mg/d, chromium 0.33 mg/d, copper 1.9 mg/d, selenium 156 μg/d, and molybdenum 232 μg/d.

(2) Heavy Metals and Harmful Elements

The dietary exposure of heavy elements and harmful elements were: lead 35.1 μg/d, cadmium 32.7 μg/d, total mercury 4.5 μg/d, methylmercury 0.6 μg/d, total arsenic 118 μg/d, inorganic arsenic 27.7 μg/d, aluminum 13.4 mg/d. The dietary intakes of lead and cadmium of different sex/age groups are 20.2~39.7 μg/d and 10.9~22.6 μg/d respectively. More attention of lead and cadmium should be paid on the 2~7 years old and 8~12 years old children and adolescents.

5. 第五次中国总膳食研究农药残留的膳食摄入量评估

（1）有机氯农药

我国居民膳食有机氯农药（OCP）摄入量分别为：滴滴涕（DDT）0.021 μg/(kg bw[①]·d)[占暂定每日可耐受摄入量（PTDI）的0.2%]、三氯杀螨醇0.014 μg/(kg bw·d)[占每日允许摄入量（ADI）的0.7%]、六六六（HCH）0.008 μg/(kg bw·d)（占PTDI的0.8%）、硫丹0.030 μg/(kg bw·d)（占PTDI的0.5%）、六氯苯（HCB）0.001 μg/(kg bw·d)（占PTDI的0.5%）、艾氏剂和狄氏剂0.007 μg/(kg bw·d)（占PTDI的6.8%）、异狄氏剂0.010 μg/(kg bw·d)（占PTDI的0.5%）、氯丹0.001 μg/(kg bw·d)（占PTDI的0.3%）、七氯0.006 μg/(kg bw·d)（占PTDI的6.4%）。水产类、肉类、乳类、蛋类、豆类、谷类、薯类和蔬菜类对膳食有机氯农药摄入均有贡献。

（2）拟除虫菊酯类农药

我国居民拟除虫菊酯类农药（PY）的膳食暴露量分别为：氯氰菊酯0.041 μg/(kg bw·d)（占ADI的0.2%）、氯菊酯0.028 μg/(kg bw·d)（占ADI的0.06%）、苯醚菊酯0.017 μg/(kg bw·d)、氯氟氰菊酯0.008 μg/(kg·bw·d)（占ADI的0.04%）、甲氰菊酯0.003 μg/(kg bw·d)（占ADI的0.01%）、丙烯聚酯0.003 μg/(kg bw·d)、氰戊菊酯0.002 μg/(kg bw·d)（占ADI的0.01%）、胺菊酯0.002 μg/(kg bw·d)、联苯菊酯0.002 μg/(kg bw·d)（占ADI的0.02%）、炔丙菊酯0.0005 μg/(kg bw·d)、溴氰菊酯0.000 03 μg/(kg bw·d)（占ADI的0.0003%）。

5. The Dietary Intakes of Pesticide Residues of 5th China TDS

(1) Organochlorine Pesticides

The dietary intakes of organochlorine pesticides (OCPs)[percent of provisional tolerable daily in take (PTDI) or acceptable daily intake (ADI)] were: DDT 0.021 μg/(kg bw·d) (0.2% of PTDI)、dicofol 0.014 μg/(kg bw·d) (0.7% of ADI), HCHs 0.008 μg/(kg bw·d) (0.8% of PTDI), endosulfan 0.030 μg/(kg bw·d) (0.5% of PTDI), HCB 0.001 μg/(kg bw·d) (0.5% of PTDI), aldrin and dieldrin 0.007 μg/(kg bw·d) (6.8% of PTDI), endrin 0.010 μg/(kg bw·d) (0.5% of PTDI), chlordane 0.001 μg/(kg bw·d) (0.3% of PTDI), heptachlor 0.006 μg/(kg bw·d) (6.4% of PTDI). The foods contributing to dietary OCPs were aquatic foods, meats, dairy products, eggs, legumes, cereals, potatoes, and vegetables.

(2) Pyrethroid Pesticides

The dietary exposure of pyrethroid pesticides (PYs) (%ADI) were: cypermethrin 0.041 μg/(kg bw·d) (0.2%), permethrin 0.028 μg/(kg bw·d) (0.06%), bifenthrin 0.017 μg/(kg bw·d), cyhalothrin 0.008 μg/(kg bw·d) (0.04%), fenpropathrin 0.003 μg/(kg bw·d) (0.01%), allethrin 0.003 μg/(kg bw·d), fenvalerate 0.002 μg/(kg bw·d) (0.01%), tetramethrin 0.002 μg/(kg bw·d), bifenthrin 0.002 μg/(kg bw·d) (0.02%), prallethrin 0.0005 μg/(kg bw·d), deltamethrin 0.000 03 μg/(kg bw·d) (0.0003%).

① bw 表示体重，bw means weight

（3）有机磷农药

我国居民有机磷农药膳食摄入量分别为：敌敌畏 0.000 24 μg/(kg bw · d)（占 ADI 的 0.005%）、毒死蜱 0.0004 μg/(kg bw · d)（占 ADI 的 0.004%）、久效磷 0.003 μg/(kg bw · d)（占 ADI 的 0.4%）、水胺硫磷 0.0006 μg/(kg bw · d)（占 ADI 的 0.02%）、倍硫磷 0.004 μg/(kg bw · d)（占 ADI 的 0.06%）、内吸磷 0.0002 μg/(kg bw · d)（占 ADI 的 0.4%）、甲基内吸磷 0.0004 μg/(kg bw · d)（占 ADI 的 0.1%）。膳食有机磷农药的膳食摄入来源是肉类和水产类。

（4）三嗪类农药

我国居民三嗪类农药灭蝇胺的膳食摄入量为 10.77 μg/d，占 ADI 的 0.29%。膳食灭蝇胺的食物来源为蔬菜类（62.5%）、蛋类（13.4%）、肉类（11.2%）、薯类、豆类、水产类、糖类、水果类共占总摄入来源的 12.9%。

6. 第五次中国总膳食研究兽药残留的膳食摄入量评估

我国居民兽药的膳食暴露量为：克伦特罗 0.0043 μg/d（占 ADI 的 1.72%）、土霉素 0.0026 μg/d（占 ADI 的 0.0001%）、金霉素 0.0057 μg/d（占 ADI 的 0.0003%）、氧氟沙星 0.66 μg/d、恩诺沙星 0.75 μg/d（占 ADI 的 0.60%）、环丙沙星 0.39 μg/d、诺氟沙星 0.016 μg/d、磺胺甲噁唑 0.015 μg/d、磺胺嘧啶 0.0019 μg/d、磺胺二甲嘧啶 0.024 μg/d（占 ADI 的 0.0008%）、磺胺间甲氧嘧啶 0.031 μg/d、甲硝唑 1.11 μg/d、氯霉素 0.0005 μg/d。克伦特罗、氧氟沙星、诺氟沙星、磺胺甲噁唑、磺胺二甲嘧啶和磺胺间甲氧嘧啶的膳食摄入的食物来源主要为肉类膳食（＞60%）；土霉素、环丙沙星和氯霉素膳食摄入的食物主要为乳类（＞60%）；甲硝唑的食物来源主要为蛋类（87.7%）。

(3) Organophosphorus Pesticides

The dietary intakes of organophosphorus pesticides (%ADI) were: dichlorovos 0.000 24 μg/(kg bw · d) (0.005%), dichlorpyrifos 0.0004 μg/(kg bw · d) (0.004%), monocrotophos 0.003 μg/(kg bw · d) (0.4%), isocarbofos 0.0006 μg/(kg bw · d) (0.02%), fenthion 0.004 μg/(kg bw · d) (0.06%), demeton 0.0002 μg/(kg bw · d) (0.4%), demeton-S-methyl 0.0004 μg/(kg bw · d) (0.1%). The food sources of organophosphorus pesticides identified in the 5th China TDS were meats and aquatic products.

(4) Triazine Pesticides

The dietary intakes of cyromazine of Chinese residents were 10.77 μg/d (0.29% of ADI). The main food sources of dietary cyromazine was vegetables (62.5%), eggs (13.4%), meets (11.2%), and the other 12.9% come from potatoes, legumes, aquatic products, sugar, and fruits.

6. The Dietary Intakes of Veterinary Drugs of the 5th China TDS

The average dietary intakes of veterinary drugs for the Chinese residents were: clenbuterol 0.0043 μg/d (1.72% of ADI), oxytetracycline 0.0026μg/d (0.0001% of ADI), chlortetracycline 0.0057 μg/d (0.0003% of ADI), oflaxacin 0.66 μg/d, enrofloxacin 0.75 μg/d (0.60% of ADI), ciprofloxacin 0.39μg/d, norfloxacin 0.016μg/d, sulfamethoxazloe 0.015 μg/d, sulfadiazine 0.0019 μg/d, sulfadimidine 0.0024 μg/d (0.0008% of ADI), sulfamonomethoxine 0.031 μg/d, metronidazole 1.11μg/d, chloramphenicol 0.0005 μg/d. The main food sources of clenbuterol, oflaxacin, norfloxacin, sulfamethoxazole, sulfadimidine, and sulfamonomethoxine were meats (＞60%), as well as the main sources of oxytetracycline, ciprofloxacin and chloramphenicol were dairy products (＞60%). Metronidazole was mainly from eggs (87.7%).

7. 第五次中国总膳食研究生产加工过程污染物的膳食摄入量评估

（1）氯丙醇

我国居民膳食3-氯-1,2-丙二醇（3-MCPD）的膳食摄入量为0.25 μg/(kg bw · d)，占暂定每日最大可耐受摄入量（PMTDI）的12.5%。第五次中国总膳食研究的膳食3-MCPD主要来源于蔬菜类（43.5%）、谷类（26.4%）、薯类（11.9%）、肉类（5.2%）、水产类（2.3%），占总膳食摄入的93.6%。

（2）氯丙醇酯

我国居民膳食3-MCPD酯的膳食摄入量为1.32 μg/(kg bw · d)，占3-MCPD的PMTDI的66.0%。第五次中国总膳食研究的膳食3-MCPD酯主要来源于蔬菜类（58.8%）、肉类（15.1%）、薯类（6.9%）、谷类（6.5%）和蛋类（5.6%），占总膳食摄入的92.9%。

（3）邻苯二甲酸酯

我国居民邻苯二甲酸酯（PAE）每日膳食摄入量水平为邻苯二甲酸二甲酯（DMP）125.19 μg/d、邻苯二甲酸二异丁酯（DIBP）233.88 μg/d、邻苯二甲酸二丁酯（DBP）376.06 μg/d（占TDI的59.69%）、邻苯二甲酸二(2-乙基)己酯（DEHP）391.08 μg/d（占TDI的12.42%）和邻苯二甲酸丁基苄基酯（BBP）66.24 μg/d（占TDI的0.21%）。DMP的膳食摄入的食物来源为谷类、肉类、蔬菜类和饮料及水，分别为50.4%、16.3%、13.1%和10.6%。DIBP的膳食摄入的食物来源为谷类、蔬菜类、肉类和饮料及水，分别为44.5%、23.9%、11.7%和10.6%。DBP的膳食摄入的食物来源为谷类、蔬菜类、饮料及水和肉类，分别为46.9%、26.8%、9.1%和8.9%。DEHP的膳食摄入的食物来源

7. The Dietary Intakes of Contaminants from Food Processing of 5th China TDS

(1) Chloropropanols

The dietary exposure of 3-chloro-1, 2-propanediol (3-MCPD) of Chinese residents stood at 0.25 μg/(kg bw · d), accounting for 12.5% of the provisional maximum tolerable daily intake (PMTDI). The main dietary sources of 3-MCPD intake identified are vegetables (43.5%), cereals (26.4%), potatoes (11.9%), meats (5.2%), aquatic products (2.3%), accounting for 93.6% of the total intake.

(2) Chloropropanols Fatty Acid Esters

The dietary exposure of 3-MCPD esters of Chinese residents stood at 1.32 μg/(kg bw · d), accounting for 66.0% of the PMTDI of 3-MCPD. The main dietary sources of 3-MCPD esters intake identified are vegetables (58.8%), meats (15.1%), potatoes (6.9%), cereals (6.5%), and eggs (5.6%), accounting for 92.9% of the total intake.

(3) Phthalic Acid Esters

The average dietary intakes of phthalic acid esters (PAEs) for Chinese residents were dimethyl phthalate (DMP) 125.19 μg/d, DIBP 233.88 μg/d, di-butylphalate (DBP) 376.06 μg/d (59.69% of TDI), di (2-ethylhexyl) phthalate (DEHP) 391.08 μg/d (12.42% of TDI), and butyl benzyl phthalate (BBP) 66.24 μg/d (0.21% of TDI). The main food sources of DMP, in the 5th China TDS were cereals, meats, vegetables, and beverages and water, contributing 50.4%, 16.3%, 13.1%, and 10.6%, respectively. DIBP was mainly from cereals, vegetables, meats, and beverages and water, contributing 44.5%, 23.9%, 11.7% and 10.6%, respectively. Cereals, vegetables, beverages and water, and meats contributed significantly to dietary exposure to DBP, contributing 46.9%, 26.8%, 9.1%, and 8.9%, respectively. Cereals, vegetables, legumes and potatoes contributed significantly to dietary

为谷类、蔬菜类、豆类和薯类，分别为53.9%、19.3%、9.1%和8.4%。BBP的膳食摄入的食物来源为谷类、蔬菜类和饮料及水，分别为52.0%、18.1%和12.9%。

8. 第五次中国总膳食研究持久性有机污染物的膳食摄入量评估

我国居民（成年男子）二噁英类物质的平均月摄入量为15.3 pg TEQ/kg bw，为暂定每月耐受摄入量（PTMI）的21.9%。水产类和肉类是主要来源，对二噁英类物质膳食摄入量的贡献分别为42.0%和37.9%。我国居民（成年男子）指示性多氯联苯（PCB）的平均日摄入量为0.65 ng/kg bw，水产类食品是主要的膳食摄入来源，其贡献率为48.2%，其次为蔬菜类，贡献率为17.2%。我国居民（成年男子）多溴联苯醚（PBDE）的平均日摄入量为0.62 ng/kg bw，水产类和肉类是主要来源，其贡献分别为23.1%和22.5%。我国居民（成年男子）六溴环十二烷（HBCD）的平均日摄入量为1476.2 pg/kg bw，肉类是主要来源，贡献率为75.2%。

9. 第五次中国总膳食研究真菌毒素的膳食摄入量评估

我国居民各类主要真菌毒素的膳食暴露量分别为：黄曲霉毒素BG (AFBG) 9.53 ng/(kg bw · d)，T-2毒素与HT-2毒素0.052 μg/(kg bw · d)，脱氧雪腐镰刀菌烯醇（DON）、3-乙酰-脱氧雪腐镰刀菌烯醇（3-Ac-DON）与15-乙酰-脱氧雪腐镰刀菌烯醇（15-Ac-DON）共0.434 μg/(kg bw · d)，雪腐镰刀菌烯醇（NIV）0.043 μg/(kg bw · d)，赭曲霉毒素A（OTA）0.577 ng/(kg bw · d)，玉米赤霉烯酮（ZON）21.7 ng/(kg bw · d)，伏马毒素0.055 μg/(kg bw · d)，展青

exposure to DEHP, contributing 53.9%, 19.3%, 9.1%, and 8.4%, respectively. While, BBP was mainly from cereals, vegetables, and beverages and water, contributing 52.0%, 18.1%, and 12.9%, respectively.

8. The Dietary Intakes of Persistent Organic Pollutants of 5th China TDS

The average monthly dioxin-like compounds intake of Chinese residents (male adults) was 15.3 pg TEQ/kg bw that was 21.9% of provisional tolerable monthly intake (PTMI). Aquatic foods and meats were the primary dietary sources of dioxin-like compounds, accounting for 42.0% and 37.9%, respectively. The average daily marker polychlorinated biphenyls (PCBs) intake of Chinese residents (male adults) was 0.65 ng/kg bw. Aquatic foods and vegetables were the primary dietary sources, accounting for 48.2% and 17.2%, respectively. The average daily polybrominated diphehyl ethers (PBDEs) intake of Chinese residents (male adults) was 0.62 ng/kg bw. Aquatic foods and meats were the primary dietary sources, accounting for 23.1% and 22.5%. The average daily hexabromocyclododecanes (HBCDs) intake of Chinese residents (male adults) was 1476.2 pg/kg bw. Meats were the primary sources, accounting for 75.2%.

9. The Dietary Intakes of Mycotoxins of 5th China TDS.

The dietary exposure of major mycotoxins were: aflatoxin BG (AFBG) 9.53 ng/(kg bw · d), T-2 and HT-2 0.052 μg/(kg bw · d), the sum of deoxynivalenol (DON), 3-acetyl-deoxynivalenol (3-Ac-DON), and 15-acetyl-deoxynivalenol (15-Ac-DON) 0.434 μg/(kg bw · d), nivalenol (NIV) 0.043 μg/(kg bw · d), ochratoxin A (OTA) 0.577 ng/(kg bw · d), zearalenone (ZON) 21.7 ng/(kg bw · d), fumonisins 0.055 μg/(kg bw · d), and patulin 2.58 ng/(kg bw · d). The dietary intakes of NIV, OTA, fumonisins, and patulin were all