



Alimentos de origem biológica nas escolas



Daniela Seabra, Nutricionista

Seminário Nacional Eco-escolas

Leiria, 22 Janeiro 2016



Dra Cristina Sales

nutriçãofuncional

A criança aprende a comer e a pensar sobre os alimentos por experiência e pelo exemplo dado pelos adultos.









Hábitos alimentares aprendidos quando criança ditarão em grande parte o que se comerá na idade adulta.





Agricultura Biológica

Sistema agrícola
sustentável

Alimentos frescos,
saborosos e
autênticos

Ausência de OGM



Incorporação de
matéria orgânica

Respeitar os
ciclos de vida
naturais

Ausência de adubos
sintéticos

Baseado na actividade
biológica do solo



Dra Cristina Sales

nutriçãofuncional

Agricultura Biológica vs Convencional

Riqueza nutricional





Agricultura Biológica versus Convencional

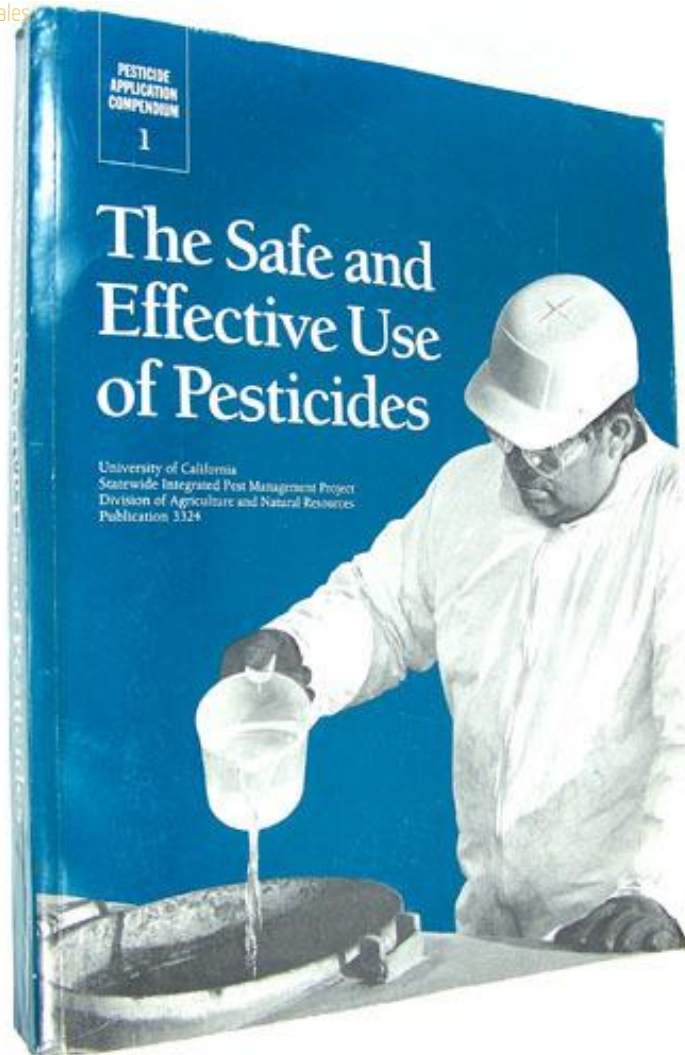
Teor de agrotóxicos

Bactérias multirresistentes

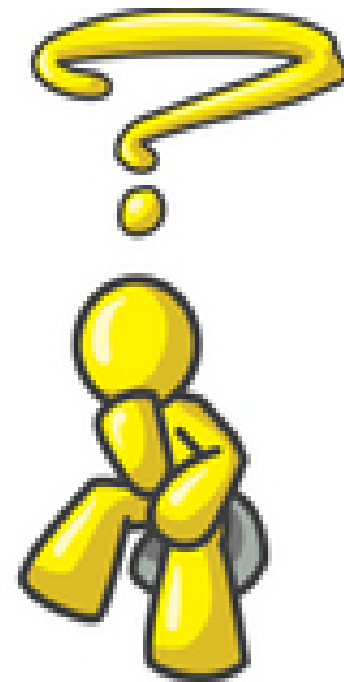




Dra Cristina Sales



Agrotóxicos



Historical use of DDT...



Norsk Barnemuseum





Dra Cristina Sales

nutrição funcional

Agricultura convencional



**Doses usadas estão dentro dos limites
considerados seguros**

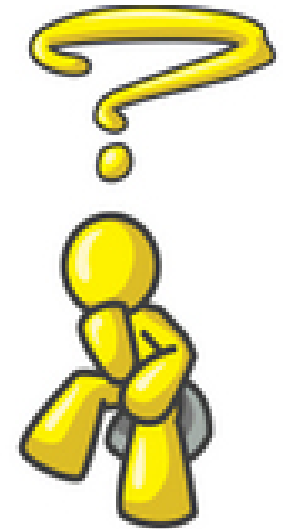


Dra Cristina Sales

nutrição funcional

Mas....

....Como se determina a dose segura?





Toxicologia clássica



Quantidade necessária para induzir alterações

Toxicogenómica



Silenciamento ou ativação da expressão genética

[Display Settings:](#) ☒ Abstract

[Send to:](#) ☒

Toxicology. 2013 May 10;307:35-41. doi: 10.1016/j.tox.2013.01.017. Epub 2013 Feb 1.

Epigenetics and pesticides.

Collotta M, Bertazzi PA, Bollati V.

Center of Molecular and Genetic Epidemiology, Department of Clinical Sciences and Community Health, Università degli Studi di Milano and Fondazione IRCCS Ospedale Maggiore Policlinico, Mangiagalli e Regina Elena, Via San Barnaba 8, Milan 20122, Italy.

Abstract

Pesticides, a wide class of environmental contaminants, may cause both acute and delayed health effects in exposed subjects. These effects can range from simple irritation of the skin and eyes to more severe effects such as affecting the nervous system, the reproductive system and cancer. The molecular mechanisms underlying such effects are still under investigation. Epigenetics is the study of heritable changes in gene expression that occur without a change in the DNA sequence. Several epigenetic mechanisms, including DNA methylation, histone modifications and microRNA expression, can be triggered by environmental factors. We review current evidences indicating that epigenetic modifications may mediate pesticide effects on human health. In vitro, animal, and human investigations have identified several classes of pesticides that modify epigenetic marks, including endocrine disruptors, persistent organic pollutants, arsenic, several herbicides and insecticides. Several investigations have examined the

Diferentes mecanismos epigenéticos, incluindo metilação do DNA, modificação das histonas, ou expressão do RNA, podem ser desplotados por factores ambientais.

Em estudos in vitro, com animais e em humanos, foram identificados diferentes classes de pesticidas capazes de alterar marcadores genéticos.

Display Settings: ☒ Abstract

Toxicology. 2013 May 10;307:42-5. doi: 10.1016/j.tox.2013.01.008. Epub 2013 Jan 24.

Pesticides and oncogenic modulation.

Vakonaki E, Androutsopoulos VP, Liesivuori J, Tsatsakis AM, Spandidos DA.

Laboratory of Toxicology, University of Crete, Medical School, Crete 71409, Greece.

Abstract

Pesticides constitute a diverse class of chemicals used for the protection of agricultural products. Several lines of evidence demonstrate that organochlorine and organophosphate pesticides can cause malignant transformation of cells in in vitro and in vivo models. In the current minireview a comprehensive summary of recent in vitro findings is presented along with data reported from human population studies, regarding the impact of pesticide exposure on activation or dysregulation of oncogenes and tumor suppressor genes. Substantial mechanistic work suggests that pesticides are capable of inducing mutations in oncogenes and increase their transcriptional expression in vitro, whereas human population studies indicate associations between pesticide exposure levels and mutation occurrence in cancer-related genes. Further work is required to fully explore the exact mechanisms by which pesticide exposure affects the integrity and normal function of oncogenes and tumor suppressor genes in human populations.

Copyright © 2013 Elsevier Ireland Ltd. All rights reserved.

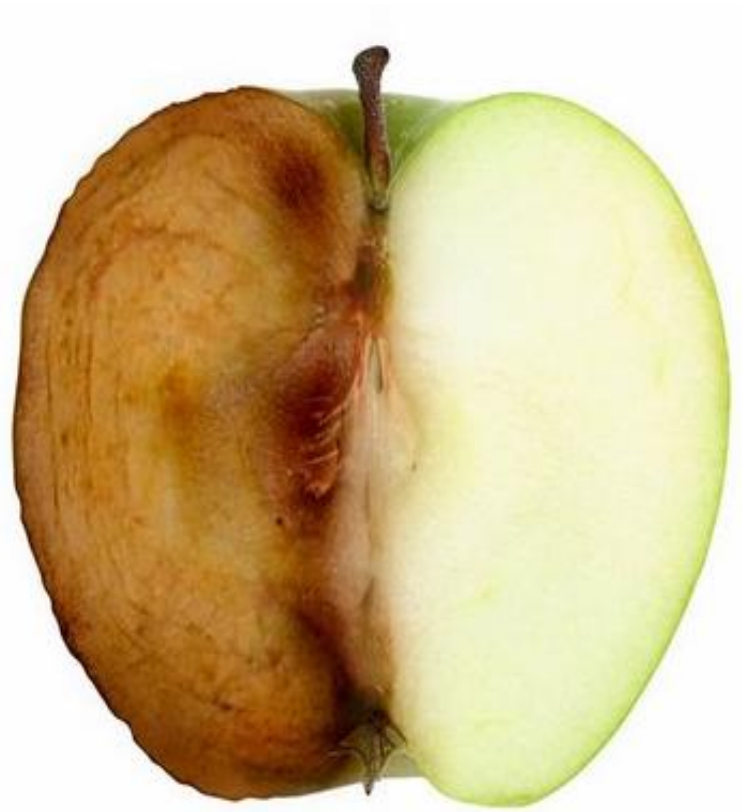
Diferentes estudos referem que os pesticidas são capazes de induzir mutações genéticas nos oncogenes, e de aumentar a sua expressão genética in vitro.



Dra Cristina Sales

nutriçãofuncional

Stress oxidativo

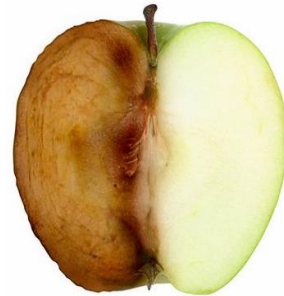




Stress oxidativo

Doenças
Cardiovasculares

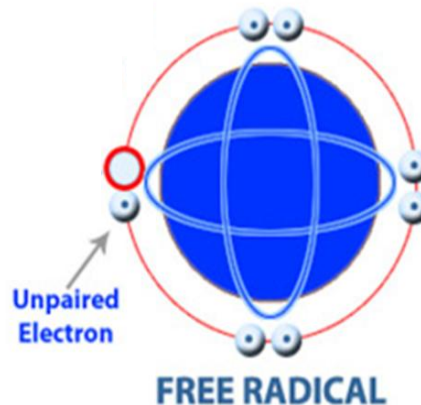
Rugas e perda de
vitalidade da pele



Envelhecimento
precoce

Fadiga crónica

Stress físico e
psíquico



Doenças
degenerativas -
cancro

Doenças neurológicas
Alzheimer e demências

Received: 2003.09.15
Accepted: 2004.01.02
Published: 2004.06.03

Pesticides and oxidative stress: a review

Mohammad Abdollahi, Akram Ranjbar, Shahin Shadnia, Shekoufeh Nikfar, Ali Rezaie

Department of Toxicology & Pharmacology, Faculty of Pharmacy and Laboratory of Toxicology, Pharmaceutical Sciences Research Center, Tehran University of Medical Sciences, Tehran, Iran

Source of support: Self financing.

RA

Todos os estudos aqui mencionados, realizados em humanos ou animais, suportam a ideia de que os pesticidas induzem stress oxidativo como um dos mecanismos de toxicidade no organismo.

Tendo em conta o envolvimento do stress oxidativo na patofisiologia de diferentes patologias crónicas no Homem, sugere-se uma maior precaução no uso de pesticidas no ambiente.



Dra Cristina Sales

nutriçãofuncional

Agricultura Biológica vs Convencional

Teor em antioxidantes



Agrotóxicos





Dra Cristina Sales

Agricultura Biológica vs Convencional



Se.....

agrotóxicos ↑ stress oxidativo...

↑ stress oxidativo ↑ necessidade de antioxidantes...

Se consumir agrotóxicos, não vou precisar de mais antioxidantes?



Dra Cristina Sales

nutrição funcional

Agrotóxicos

Agricultura convencional



**Doses usadas estão dentro dos limites
considerados seguros**



Toxicologia clássica



Quantidade necessária para induzir alterações

Toxicogenómica



Silenciamento ou ativação da expressão genética



Toxicologia clássica



Quantidade necessária para induzir alterações

Toxicogenómica



Silenciamento ou ativação da expressão genética

Disrupção endócrina

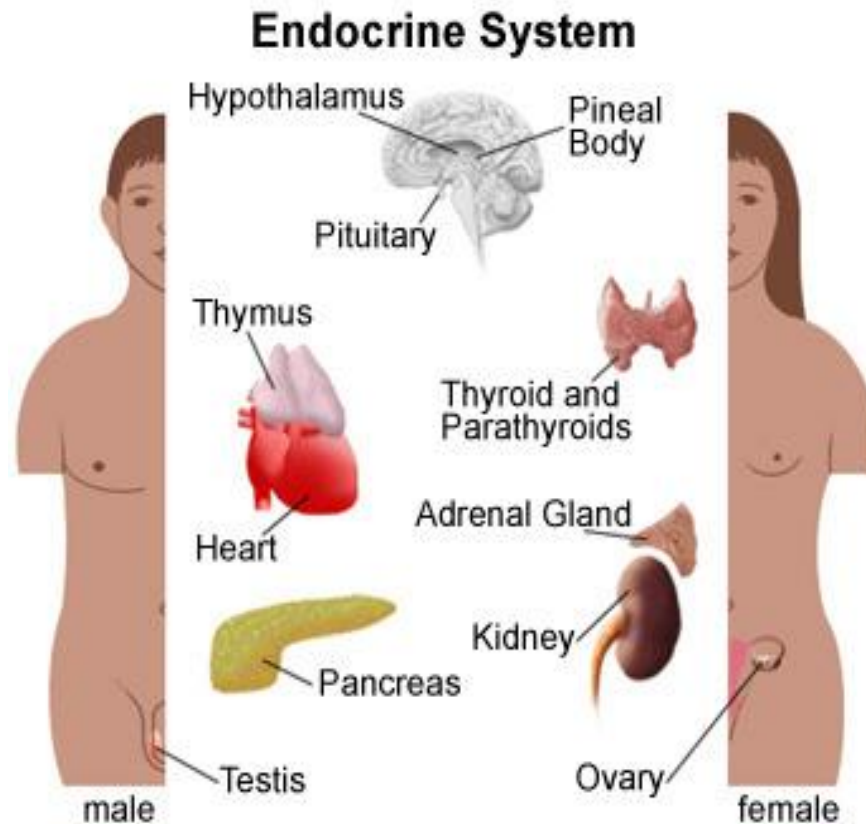


Interferência na ação hormonal / endócrina



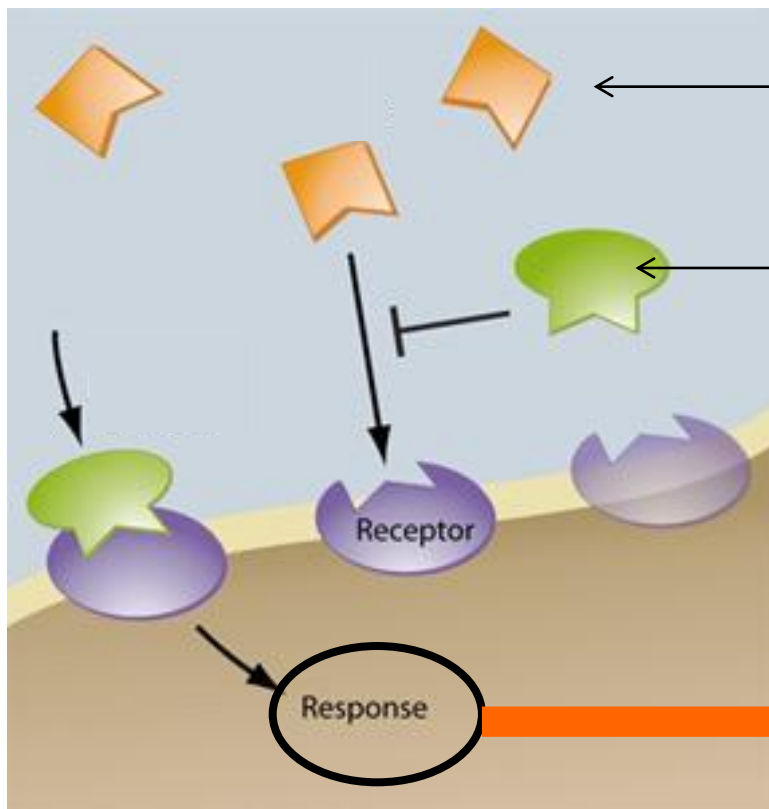
Dra Cristina Sales

Comunicação Hormonal





Disruptores Hormonais



Hormona

Disruptor
Hormonal

Ordem $\neq$

Resposta $\neq$

Endocrine-Disrupting Chemicals

An Endocrine Society Scientific Statement



Dra Cristina Sales

nutriçãofuncional

Endocrine Society Scientific Statement

Endocrine-Disrupting
Chemicals

An Endocrine Society Scientific Statement



Existem evidências de que os disruptores endócrinos têm efeitos na reprodução masculina e feminina, no desenvolvimento do cancro da mama, próstata, na neuroendocrinologia, assim como na endocrinologia tiroidea, cardiovascular, metabolismo e obesidade.

Diamanti-Kandarakis E. **Endocrine-Disrupting Chemicals: An Endocrine Society Scientific Statement.** Endocr Rev. 2009 Jun; 30(4): 293–342.



Dra Cristina Sales

nutriçãofuncional

Endocrine Society Scientific Statement

Endocrine-Disrupting
Chemicals

An Endocrine Society Scientific Statement



Os resultados obtidos em estudos com modelos animais, observações clínicas em humanos e estudos epidemiológicos convergem, e implicam os disruptores endócrinos, tornando-os uma preocupação de saúde pública.

Diamanti-Kandarakis E. **Endocrine-Disrupting Chemicals: An Endocrine Society Scientific Statement.** Endocr Rev. 2009 Jun; 30(4): 293–342.

Review

Effect of Endocrine Disruptor Pesticides: A Review

Wissem Mnif ^{1,2}, Aziza Ibn Hadj Hassine ¹, Aicha Bouaziz ¹, Aghleb Bartegi ³, Olivier Thomas ⁴
and Benoit Roig ^{4,*}

Muitos dos compostos químicos considerados disruptores endócrinos são pesticidas (105 substâncias)

Existem pelo menos 10 pesticidas com capacidade de interferir com a função tireóidea

As crianças são extremamente vulneráveis à exposição a disruptores endócrinos.



Dra Cristina Sales

nutrição funcional

Agricultura convencional



**Doses usadas estão dentro dos limites
considerados seguros**

Differential Effects of Glyphosate and Roundup on Human Placental Cells and Aromatase

Sophie Richard, Safa Moslemi, Herbert Sipahutar, Nora B.

Laboratoire de Biochimie et Biologie Moleculaire, USC-INCRA, Unive

Conclusion

Our studies show that glyphosate acts as a disruptor of mammalian cytochrome P450 aromatase activity from concentrations 100 times lower than the recommended use in agriculture; this is noticeable on human placental cells after only 18 hr, and it can also affect aromatase gene expression. It also partially disrupts the ubiquitous reductase activity but at

Roundup is a glyphosate-based herbicide used worldwide, including on mo plants that have been designed to tolerate it. Its residues may thus ente glyphosate is found as a contaminant in rivers. Some agricultural workers pregnancy problems, but its mechanism of action in mammals is questione glyphosate is toxic to human placental JEG3 cells within 18 hr with conc those found with agricultural use, and this effect increases with concentrat presence of Roundup adjuvants. Surprisingly, Roundup is always more toxi dient. We tested the effects of glyphosate and Roundup at lower nontoxic

O Glifosato é capaz de alterar a expressão genética da enzima aromatase 18h após exposição, e em concentrações 100 vezes mais baixas que as recomendadas para uso agrícola.

Os excipientes presentes no Roundup potenciam o efeito de interrupção endócrina do glifosato.

Consideramos um Roundup um potente disruptor endócrino



Dra Cristina Sales

Int. J. Environ. Res. Public Health 2010, 7, 2988–3005; doi:10.3390/ijerph7072988

OPEN ACCESS

International Journal of
Environmental Research and
Public Health
ISSN 1660-4601
www.mdpi.com/journal/ijerph

Article

Endocrine Disruptors and Obesity: An Examination of Selected Persistent Organic Pollutants in the NHANES 1999–2002 Data

Mai A. Elabbad ^{1,2}, David W. Broek ³, David B. Allison ^{1,3,4,*}, Miguel A. Padilla ^{5,6}
and Douglas M. Ruder ⁷

¹ Department of Biostatistics, University of Alabama at Birmingham, 1665 University Boulevard, Birmingham, AL, USA, 35294; E-Mail: maielabbad@gmail.com

² Division of Cardiovascular Disease, Department of Medicine, University of Alabama at Birmingham, 1665 University Boulevard, Birmingham, AL 35294, USA; E-Mail: David.Broek@uab.edu

³ Department of Nutrition Sciences, University of Alabama at Birmingham, 1665 University Boulevard, Birmingham, AL 35294, USA

⁴ Clinical Nutrition Research Center, University of Alabama at Birmingham, 1665 University Boulevard, Birmingham, AL 35294, USA

⁵ Department of Psychology, Old Dominion University, 250 Mills Godwin Building, Norfolk, VA 23529, USA; E-Mail: mpadilla@odu.edu

⁶ Department of Mathematics and Statistics, Old Dominion University, 250 Mills Godwin Building,

Endocrine Disruptors and Obesity:
An Examination of Selected Persistent Organic Pollutants
in the NHANES 1999–2002 Data. BMI and WC are
associated with POP levels, making the chemicals plausible
contributors to the obesity epidemic.

Int J Environ Res Public Health. 2010 July; 7(7): 2988–3005

Obesogens

An Environmental Link to Obesity



Transmission electron micrograph of human fat cells. Research to date suggests that different obesogens may have different mechanisms of action, affecting either the number or size of fat cells or the hormones that affect appetite, satiety, food preferences, and metabolism.

Known and Suspected Obesogens

Diet

- Fructose
- Genistein
- Monosodium Glutamate

Smoking*

- Nicotine

Pharmaceuticals

- Diethylstilbestrol
- Estradiol

Industrial Chemicals

- Bisphenol A (BPA)
- Organotins
- Perfluorooctanoic Acid (PFOA)
- Phthalates
- Polybrominated Diphenyl Ethers (PBDEs)
- Polychlorinated Biphenyl Ethers (PCBs)

Organophosphate Pesticides

- Chlorpyrifos
- Diazinon
- Parathion

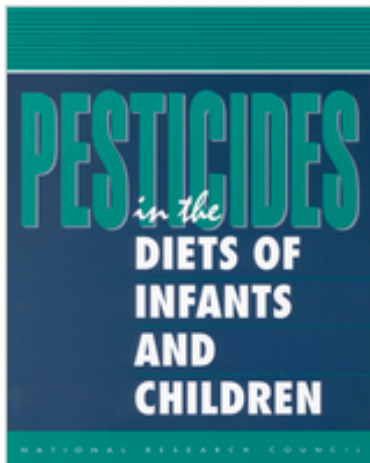
Other Environmental Pollutants

- Benzo[a]pyrene
- Fine Particulate Matter (PM_{2.5})
- Lead

* Cigarette smoke is also a source of exposure to benzo[a]pyrene and PM_{2.5}.

en steadily in the United States over the past with a marked uptick in recent decades.² In the s today more than 35% of adults³ and nearly ren aged 2–19 years are obese.⁴ Obesity plagues st in the United States but worldwide, including, developing countries.⁵ Even animals—pets, animals, and urban rats—have experienced increases decades,⁶ trends not necessarily explained by Lustig, a professor of clinical pediatrics at the Even those at the lower end of the BMI [body mass s happening is happening to everyone, suggesting

ology communities remain wedded to poor diet sity. However, researchers are gathering convincing pharmaceutical, and industrial compounds that e some people to gain weight.^{8,9} ent could be contributing to the obesity ayla Baillie-Hamilton, published in the *Journal of* 2002.¹⁰ Her article presented evidence from earlier he 1970s in which low-dose chemical exposures



Pesticides in the Diets of Infants and Children

[< Prev](#)[Next >](#)

National Research Council (US) Committee on Pesticides in the Diets of Infants and Children.

Washington (DC): [National Academies Press \(US\)](#); 1993.

ISBN-10: 0-309-04875-3

[Copyright and Permissions](#)

[Hardcopy Version at National Academies Press](#)

Search this book

Many of the pesticides applied to food crops in this country are present in foods and may pose risks to human health. Current regulations are intended to protect the health of the general population by controlling pesticide use. This book explores whether the present regulatory approaches adequately protect infants and children, who may differ from adults in susceptibility and in dietary exposures to pesticide residues.

The committee focuses on four major areas:

- *Susceptibility:* Are children more susceptible or less susceptible than adults to the effects of dietary exposure to pesticides?
- *Exposure:* What foods do infants and children eat, and which pesticides and how much of them are present in those foods? Is the current information on consumption and residues adequate to estimate exposure?
- *Toxicity:* Are toxicity tests in laboratory animals adequate to predict toxicity in human infants and children? Do the extent and type of toxicity of some chemicals vary by species and by age?
- *Assessing risk:* How is dietary exposure to pesticide residues associated with response? How can laboratory data on lifetime exposures of animals be used to derive meaningful estimates of risk to children? Does risk accumulate more rapidly during the early years of life?



Dra Cristina Sales

Alimentação biológica e as crianças

Crianças $\neq$ Adultos Pequenos

> Ingestão alimentos por peso corporal

> Ingestão de agrotóxicos por peso corporal

Imaturidade dos sistemas de desintoxicação

Imaturidade neurológica e imunitária





Dra Cristina Sales

nutrição funcional

Vias de exposição





As crianças estão em risco de exposição a pesticidas de diferentes fontes, e em níveis diferentes dos adultos.

O ritmo respiratório, o batimento cardíaco e o seu metabolismo é diferente dos adultos.

Para além disso, a quantidade de alimentos consumidos por kg de peso coloca-os numa categoria de exposição a pesticidas diferente dos adultos.

Parece prudente minimizar a exposição das crianças aos pesticidas sempre que possível.

Garry V. **Pesticides and children**. Toxicology and Applied Pharmacology 198 (2004) 152–163



Os resultados encontrados suportam a hipótese de que a exposição a pesticidas organofosforados, em níveis comuns nas crianças americanas, podem contribuir para a prevalência do síndrome de hiperatividade e déficit de atenção.

Bouchard M. Attention-Deficit / Hyperactivity Disorder and Urinary Metabolites of Organophosphate pesticides. *Pediatrics* 2010; 125: e1270 – e1277

Existem cada vez mais evidências científicas sobre as consequências neurocomportamentais em crianças, da exposição a baixos níveis de pesticidas organoclorados e organofosforados.

As crianças portadoras de um polimorfismo a nível do gene da paraoxonase 1 (a enzima que metaboliza os pesticidas organofosforados), apresentam um risco bastante superior de manifestarem efeitos adversos.

Eskenazi B. Pesticide Toxicity and the Developing Brain. *Basic & Clinical Pharmacology & Toxicology* 2008, 102, 228–236

Residential Pesticides and Childhood Leukemia: A Systematic Review and Meta-Analysis

Michelle C. Turner,^{1,2} Donald T. Wigle,¹ and Daniel Krewski^{1,3,4}

¹McLaughlin Centre for Population Health Risk Assessment, and ²Department of Epidemiology and Community Studies, and ³Department of Epidemiology and Community Studies, and ⁴Risk Sciences International, Ottawa, Canada

OBJECTIVE: We conducted a systematic review and meta-analysis of epidemiologic studies examining the relationship between residential pesticide exposure and childhood leukemia, focusing on critical exposure time windows (preconception, pregnancy, and childhood).

DATA SOURCES: Searches of MEDLINE and other electronic databases. Reports were included if they were original epidemiologic studies using a case-control or cohort design, and assessed at least one individual pesticide exposure/use. No language criteria were applied.

DATA EXTRACTION: Study selection, data abstraction, and quality assessment by independent reviewers. Random effects models were used to estimate pooled odds ratios (ORs) and 95% confidence intervals (CIs).

DATA SYNTHESIS: Of the 17 identified studies, 15 were included in the meta-analysis. During pregnancy to unspecified residential pesticides (summary OR = 1.38; 95% CI, 1.20–2.16; $I^2 = 66\%$), insecticides (OR = 2.05; 95% CI, 1.80–2.32; $I^2 = 0\%$) were positively associated with childhood leukemia. During childhood to unspecified residential pesticides (OR = 1.38; 95% CI, 1.20–2.16; $I^2 = 66\%$), insecticides (OR = 2.05; 95% CI, 1.80–2.32; $I^2 = 0\%$) were positively associated with childhood leukemia.

Conclusions

This systematic review and meta-analysis reveals positive associations between exposure to residential pesticides in pregnancy and childhood and childhood leukemia, with the strongest associations observed for insecticides. Further work is needed to confirm previous findings based on self-report, to better describe potential exposure-response relationships, to assess specific pesticides and toxicologically related subgroups of pesticides in more detail, and to assess the potential role of preconceptional paternal exposures. Large prospective studies of children with biomarkers of pesticide exposure are needed.

Esta revisão sistemática e meta-análise revela uma associação positiva entre a exposição a pesticidas residenciais durante a gravidez e infância, e leucemia infantil, com a associação mais forte para os inseticidas.



Dieta parece ser a maior fonte de exposição das crianças a pesticidas.

Lu, C., 2001. Biological monitoring survey of organophosphorus pesticide exposure among pre- school children in the Seattle metropolitan area. Environ. Health Perspect. 109, 299–303.

Wilson, N.K. 2003. Aggregate exposures of nine preschool children to persistent organic pollutants at day care and at home. J. Exposure Anal. Environ. Epidemiol. 13, 187 – 202.

Aprea, C, 2000. Biologic monitoring of exposure to organophosphorus pesticides in 195 Italian children. Environ. Health Perspect. 108, 521–525.

Schettgen, T., 2002. Pyrethroid exposure of the general population—Is this due to diet. Toxicol. Lett. 134, 141 – 145.

Garry VF. Pesticides and children. Toxicology and Applied Pharmacology 198 (2004) 152–163

**CONVENTIONAL
CARROT**

INGREDIENTS

CARROT

42 PESTICIDES

(including the acutely toxic
Bensulide, Chlorothalonil,
Imidacloprid, Oxamyl, and
Propiconazole)

**ORGANIC
CARROT**

INGREDIENTS

CARROT

Parker's
JUICERY

Organophosphorus Pesticide Exposure of Urban and Suburban Preschool Children with Organic and Conventional Diets

Cynthia L. Curl, Richard A. Fenske, Kai Elgethun

Department of Environmental Health, School of Public Health and Community Medicine, University of Washington, Seattle, Washington USA

We assessed organophosphorus (OP) pesticide exposure from diet by biological monitoring among Seattle, Washington, preschool children. Parents kept food diaries for 3 days before urine collection, and they distinguished organic and conventional foods based on label information. Children were then classified as having consumed either organic or conventional diets based on analysis of the diary data. Residential pesticide use was also recorded for each home. We collected 24-hr urine samples from 18 children with organic diets and 21 children with conventional diets and analyzed them for five OP pesticide metabolites. We found significantly higher median concentrations of total dimethyl alkylphosphate metabolites than total diethyl alkylphosphate metabolites (0.06 and 0.02 $\mu\text{mol/L}$, respectively; $p = 0.0001$). The median total dimethyl metabolite concentration was approximately six times higher for children with conventional diets than for children with organic diets (0.17 and 0.03 $\mu\text{mol/L}$; $p = 0.0003$); mean concentrations differed by a

the Seattle, Washington, metropolitan area: a local consumer cooperative selling a large variety of organic foods and a large retail chain supermarket selling mostly conventional foods. These stores were selected because they tend to serve clientele with similar socioeconomic status (middle to upper-middle class). With permission of the store managers, customers were approached at the store entrances and asked about their interest in the study. Those who had toilet-trained children in the 2–5-year-old age range were

A concentração destes compostos nas crianças com uma alimentação convencional foi 6 vezes maior, do que nas crianças com uma alimentação biológica.

O consumo de produtos biológicos parece ser uma forma relativamente simples dos pais reduzirem a exposição dos seus filhos a estes pesticidas.

Organic Diets Significantly Lower Children's Dietary Exposure to Organophosphorus Pesticides

Chensheng Lu,¹ Kathryn Toepel,² Rene Irish,² Richard A. Fenske,² Dana B. Barr,³ and Roberto Bravo³

¹Department of Environmental and Occupational Health, Rollins School of Public Health, Emory University, Atlanta, Georgia, USA;

²Department of Environmental and Occupational Health Sciences, University of Washington, Seattle, Washington, USA; ³National Center for Environmental Health, Centers for Disease Control and Prevention, Atlanta, Georgia, USA

We used a novel study design to measure dietary organophosphorus pesticide exposure in a group of 23 elementary school-age children through urinary biomonitoring. We substituted most of children's conventional diets with organic food items for 5 consecutive days and collected two spot daily urine samples, first-morning and before-bedtime voids, throughout the 15-day study period. We found that the median urinary concentrations of the specific metabolites for malathion and chlorpyrifos decreased to the nondetect levels immediately after the introduction of organic diets and remained nondetectable until the conventional diets were reintroduced. The median concentrations for other organophosphorus pesticide metabolites were also lower in the organic diet consumption

Subject Division approved the use of human subjects in this study.

Sampling period. Each child committed to a 15-consecutive-day sampling period, which consisted of three phases. Children consumed their conventional diets during phase 1 (days 1–3) and phase 3 (days 9–15). During phase 2 (days 4–8), organic food items were substituted for most of children's conventional diet,

Em conclusão, fomos capazes de demonstrar que uma dieta biológica foi capaz de fornecer uma dramática e imediata proteção contra os efeitos da exposição a pesticidas organofosforados. Concluimos também que a maior fonte de exposição destas crianças a estes pesticidas é através da alimentação.



The Precautionary Principle



Dra Cristina Sales

nutrição funcional



**Obrigada pela
atenção!**

Daniela Seabra, Nutricionista

danielaseabra@cristinasales.pt