

Making Food Safer with Nuclear Technology

Prof. Dr. Daniel A. Wunderlin

Institute for Food Science & Technology (ICYTAC)

CONICET & NATIONAL UNIVERSITY OF CÓRDOBA (Argentina)

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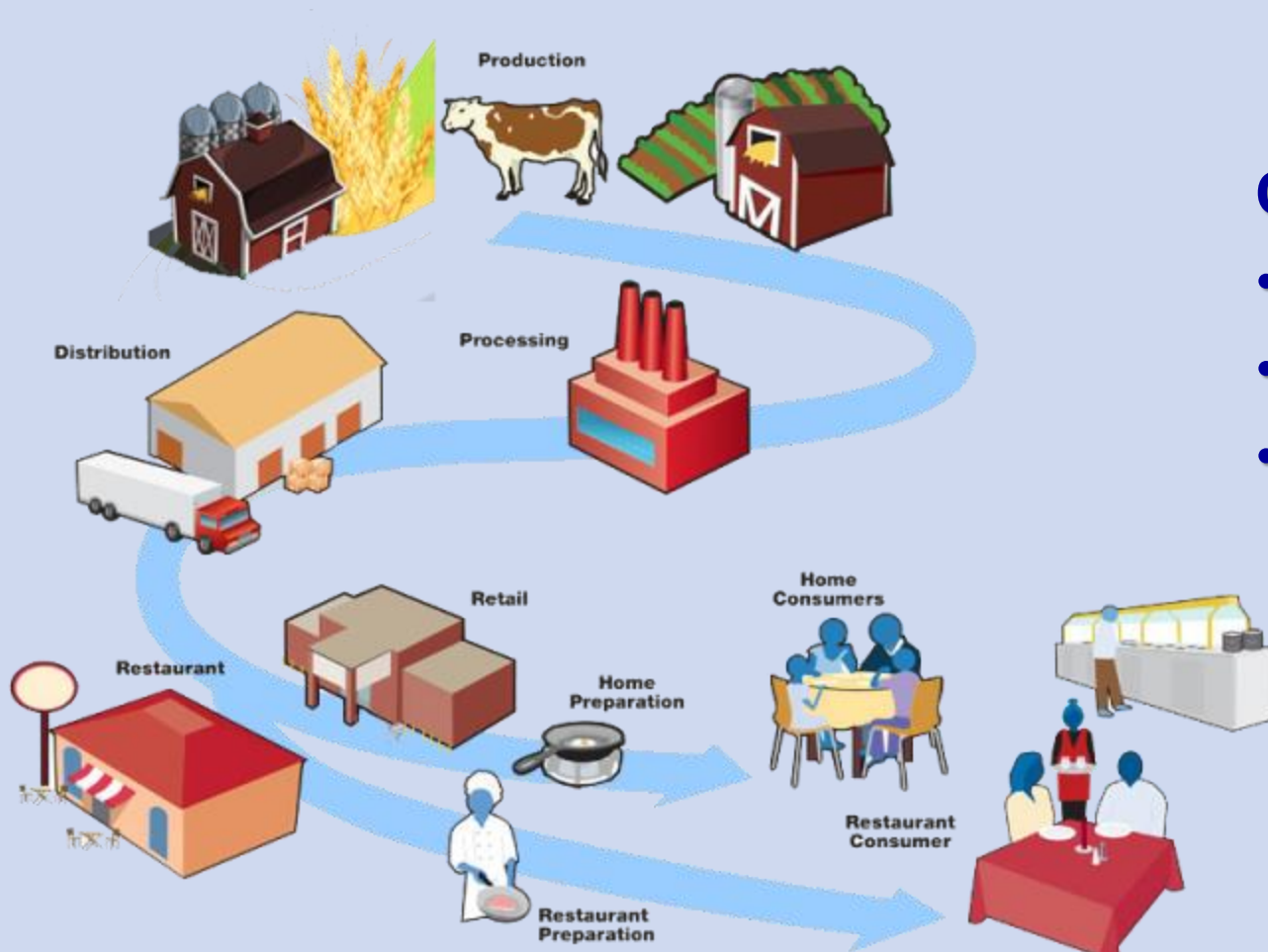
2016 IAEA Scientific Forum

**Nuclear Technology for
the Sustainable Development Goals**



Agricultural and Food Production Value Chain

“From Farm to Fork”



Critical Points

- *Production*
- *Processing*
- *Trade*

SOME OUTBREAKS / CHALLENGES/ FEARS

ASSOCIATED WITH MODERN FOOD TRADE

CAUSES

PUBLIC AWARENESS – HEALTH RISK

FOOD QUALITY



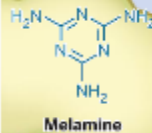
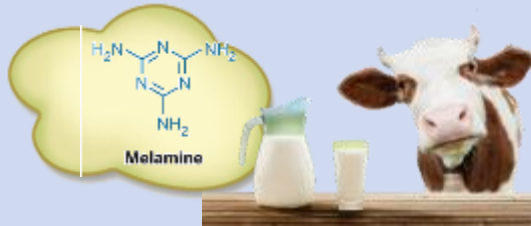
Bacteria /
Parasites
Growth



Food Contamination
Incidents



FOOD FRAUD



Food Contamination
Incidents



FOOD SAFETY



EXCESSIVE
PESTICIDES/
BANNED
PRODUCTS



Food Contamination
Incidents



FOOD DEFENSE



SOME *FOOD FRAUDS* AND ASSOCIATED *PUBLIC HEALTH RISK*

**FRAUDULENT
TRANSSHIPMENT**

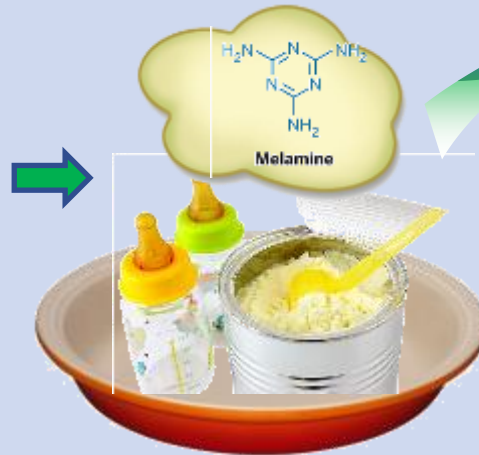


**INTRODUCE BANNED PRODUCTS
AVOID TASK – AVOID ANTIDUMPING**



**UNCERTAINTY ON FOOD ORIGIN-
HEALTH RISK FROM BANNED FOODS**

**UNAPPROVED DILUTION/
ENHANCEMENT**



**ECONOMIC GAIN – INCREASE
NITROGEN TO SIMULATE MILK
PROTEINS**

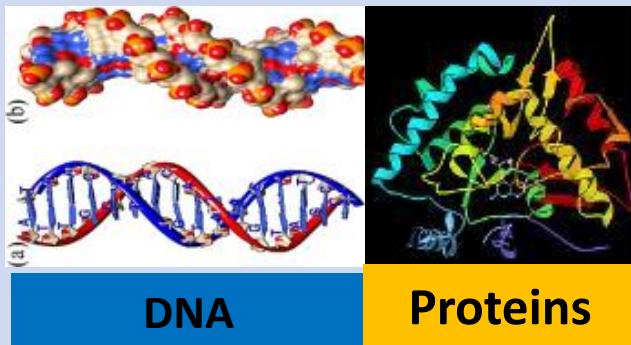
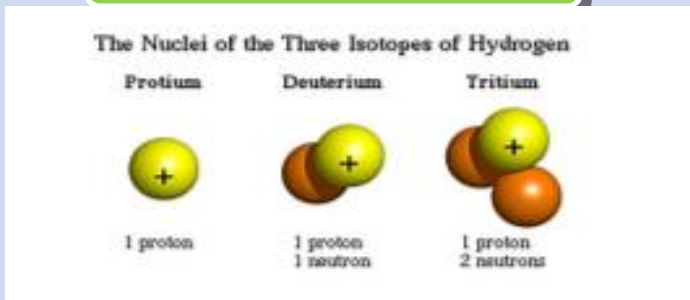


**FOOD CONTAMINATION – HEALTH RISK
INTRODUCE UNEXPECTED (NEW)
ADULTERANTS
PUBLIC FEAR ON FOODS**

HOW CAN **ATOMS HELP** with **FOOD SECURITY**?

“SINGLE/SIMPLE” LABORATORY METHODS TO COMBAT FOOD FRAUD; ASSURE FOOD SAFETY/QUALITY

STABLE ISOTOPES



☐ Radiometric & complementary techniques

- Monitor residues & contaminants
- Rapid & cheap

☐ Isotopic methods

- Combat fraud, prove origin, etc.

☐ The OMICs era

- **FoodOmics**: determine “unknowns”; species replacement; species health, etc.

HOW CAN **ATOMS HELP** with **FOOD SECURITY**?

CHALLENGING FUTURE: NEED FOR MULTHAZARD RADIOMETRIC ANALYTICAL TECHNIQUES



☐ Multiple hazards in the same products

- Monitor toxic, toxins, residues & contaminants

☐ New/emerging hazards

☐ Changing agricultural patterns

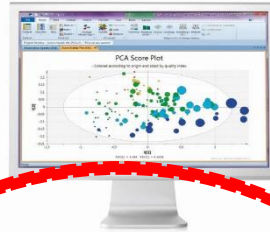
CHALLENGING THE FUTURE: USE OF COMBINED METHODS

HOW CAN ATOMS HELP WITH THE FOOD SECURITY?

PERIODIC TABLE OF THE ELEMENTS

http://www.k12-qa.com/periodic/

ATOM-BASED FOOD-FINGERPRINTS



STABLE ISOTOPES

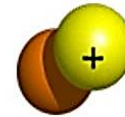
The Nuclei of the Three Isotopes of Hydrogen

Protium



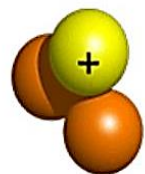
1 proton

Deuterium



1 proton
1 neutron

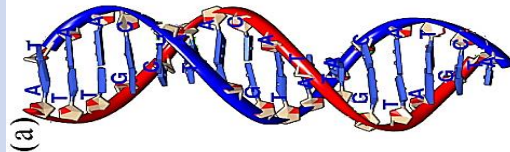
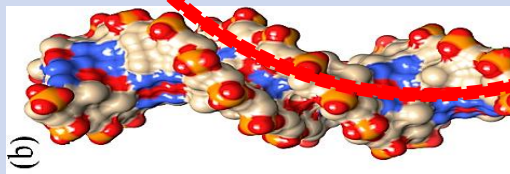
Tritium



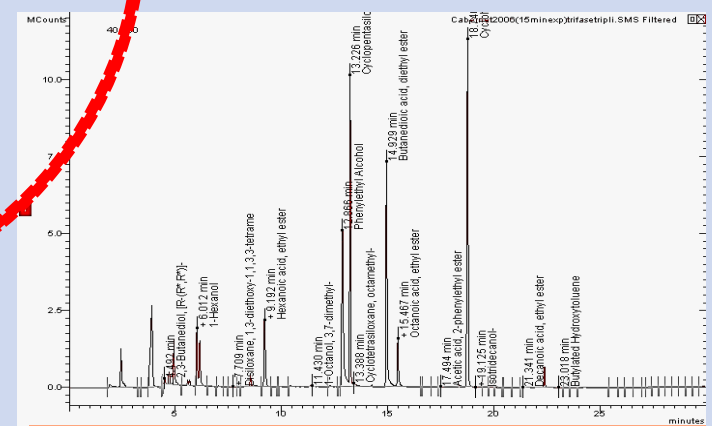
1 proton
2 neutrons



Proteins



DNA



Secondary Metabolites (Polyphenols, flavours, vitamins, etc.)

VERIFICATION OF FOOD ORIGIN (PROVENANCE): ATOM-TRACEABILITY



PERIODIC TABLE OF THE ELEMENTS

Legend:

- 1. Metals
- 2. Nonmetals
- 3. Metalloids
- 4. Noble gases
- 5. Lanthanides
- 6. Actinides

Periodic Table of the Elements

1	2											3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18			
H	He											Li	Be	B	C	N	O	F	Ne											
La		Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Fr
Ac		Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr	Rf	Db	Sg	Bh	Hl	Tl	Pb	Bi	Po	At	Fr	Ra	Ac	Th	Pa

Notes:

- 1. Elements in the same group have similar chemical properties.
- 2. Elements in the same period have similar physical properties.
- 3. Elements in the same group have similar atomic numbers.
- 4. Elements in the same period have similar atomic masses.
- 5. Elements in the same group have similar electronegativity values.
- 6. Elements in the same period have similar ionization energies.
- 7. Elements in the same group have similar electron configurations.
- 8. Elements in the same period have similar atomic radii.
- 9. Elements in the same group have similar melting points.
- 10. Elements in the same period have similar boiling points.

The Nuclei of the Three Isotopes of Hydrogen

Protium



1 proton

Deuterium



1 proton
1 neutron

Tritium



1 proton
2 neutrons



**ATOM-BASED FOOD-
“FINGERPRINTS”**



VERIFICATION OF FOOD FRAUD (FALSE ORIGIN) USING ATOM-TRACEABILITY



INCORRECT ATOM-
BASED FOOD
FINGERPRINTS

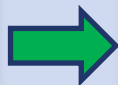
**PRODUCT SUBSTITUTION - FALSE
ORIGIN DECLARATION**



VERIFICATION OF **FOOD SAFETY:** **ATOM POLLUTION MARKERS**



CLEAN WATER / "NO
POLLUTION"



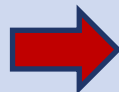
SAFE / CONTROLLED FEED
AND VETERINARY
MEDICINES



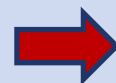
ATOM-BASED
SAFE FISH
"FINGERPRINT"



DOMESTIC / INDUSTRIAL
WATER POLLUTION



UNSAFE / UNCONTROLLED
FEED AND VETERINARY
MEDICINES



ATOM-BASED
UNSAFE FISH
"FINGERPRINT"

FEASIBLE SOLUTIONS / MITIGATION OF PUBLIC HEALTH PROBLEMS DERIVED FROM FOOD QUALITY & SAFETY ISSUES



Joint FAO/IAEA Division
of Nuclear Techniques in Food and Agriculture



中国食品安全标准与国际食品法典标准
China National Food Safety
Standards & Codex

Jianshi Chen 陈建石
China National Centre for Food Safety Risk Assessment

C O D E X
International Food Standards



FUTURE TRENDS – PARTNERSHIPS FOR FOOD SAFETY

- Internationally coordinated efforts
- Harmonized guidelines/standards, legislation
- Sound laboratories – reliable analytical methods



Supported National's food safety programmes and enhanced exports through strengthening of laboratory capabilities, personnel training, etc.

Techniques will play a leading role

Business decision

Ease of use

Thank you!



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<http://www.icytac.conicet.unc.edu.ar/>



2016 IAEA Scientific Forum

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the Sustainable Development Goals**

