Polymers and additives - their possible effect on the human body.

Dr Carl Albrecht Head Research, CANSA

Plastic Packaging: Health and the Environment, 29 March 2012, Cape Town
A few words about CANSA

- Award winning leading non-profit
- 80 years old
- Research, Education, Support
- 350 staff and over 14 000 volunteers
- Support and reach to over 500 communities nationally
- Budget: R100 M
- Research Reserves: R100 M
- Research p.a. R5-10 M
- Source of funds: Public, corporate donors & Lotto

Cancer affects us all...
A few hard facts about cancer

- Worldwide more people die of cancer (10 mil p.a.) than of AIDS, TB and malaria put together
- 100 000 diagnoses p.a. in RSA
- 60 000 die p.a. in RSA
- 40% chance to survive.
- 1 in 4 males get it
- 1 in 6 females get it.
- Men–No.1 Prostate
- Women– No.1 Breast/Cervix
Cancer is a leading cause of death worldwide.
Where does cancer come from?

- More than 90% of cancers are caused by environmental factors.
- This is very good news because it means that the vast majority of cancers can be prevented.

Cancer affects us all...
The 6 main causes of cancer

- SMOKING 30%
- VIRUSES 20%
- CHEMICALS 20%
- OBESITY 15%
- ALCOHOL 10%
- SUNLIGHT 5%

TOTAL 100%
### What are the top 4 cancers in RSA?

<table>
<thead>
<tr>
<th>Cancer</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prostate</td>
<td>37*</td>
</tr>
<tr>
<td>Cervix</td>
<td>34*</td>
</tr>
<tr>
<td>Breast</td>
<td>32*</td>
</tr>
<tr>
<td>Lungs (mans)</td>
<td>15*</td>
</tr>
</tbody>
</table>

(*per 100 000 p.a.*)
Mr. McGuire: I just want to say one word to you - just one word.
Ben: Yes sir.
Mr. McGuire: Are you listening?
Ben: Yes I am.
Mr. McGuire: *Plastics.*
Ben: Exactly how do you mean?
Mr. McGuire: There's a great future in plastics. Think about it. Will you think about it?
Ben: Yes I will.
Mr. McGuire: Shh! Enough said. That's a deal.
Key questions

1. Are plastics involved in cancer?
2. How could plastics be involved in cancer?
3. How could any danger be avoided?
What makes plastics potentially dangerous

- Polymer
- Monomer
- Plastisiser

Heat makes it worse

Cancer affects us all...
Monomers are dangerous—polymers are not
The 5 most important plastics

<table>
<thead>
<tr>
<th>Polymer</th>
<th>Monomer</th>
<th>Health aspects</th>
<th>Legislation (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyethylene</td>
<td>Ethylene</td>
<td>None found</td>
<td>None</td>
</tr>
<tr>
<td>Polypropylene</td>
<td>Propylene</td>
<td>Possible (2)</td>
<td>None</td>
</tr>
<tr>
<td>Polycarbonate</td>
<td>Bisphenol A BPA</td>
<td>Considerable</td>
<td>Banned</td>
</tr>
<tr>
<td>Polystyrene</td>
<td>Styrene</td>
<td>Carcinogenic Suspect</td>
<td>None</td>
</tr>
<tr>
<td>Polyvinylchloride</td>
<td>Vinyl chloride</td>
<td>Probable Carcinogen</td>
<td>None</td>
</tr>
</tbody>
</table>
Could this be a problem?

- **Polystyrene cups and containers: styrene migration.**
- **Tawfik MS, Huyghebaert A.**
- **Source**
- Department of Food Technology and Nutrition, Faculty of Agriculture and Applied Biological Sciences, Ghent, Belgium
LCMS at US CAF

• This is like detecting a $1/20^{th}$ of a drop of water in an Olympic swimming pool
Analytical capability

Cancer affects us all...
Aspects of release of styrene into coffee

- Temperature
- Length of exposure
- Type of coffee
- Milk vs. no milk
- Sugar vs. sweetener
- Is this health relevant
Problem with plasticisers

Plasticiser molecules behave like "molecular lubricants" allowing the polymer chains to slide over each other more easily.
Plasticisers have been banned:

<table>
<thead>
<tr>
<th>Chemical Name:</th>
<th>1,2-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC Number:</td>
<td>204-211-0</td>
</tr>
<tr>
<td>CAS Number:</td>
<td>117-81-7</td>
</tr>
<tr>
<td>IUPAC Name:</td>
<td>Bis(2-ethylhexyl)phthalate</td>
</tr>
<tr>
<td>Molecular Formula:</td>
<td>C_{24}H_{38}O_{4}</td>
</tr>
<tr>
<td>Structural Formula:</td>
<td><img src="image" alt="Structural Formula" /></td>
</tr>
</tbody>
</table>

DEHP
What are the health implications of DEHP plasticiser?

- Decreased penis width
- Shorter anogenital distance
- Incomplete descent of testes
- Drop in Fertility
- Developmental toxicity
- Obesity
- Insulin resistance

- Following plastisisers banned
  - DEHP
  - DBP
  - BBP
  - DINP
  - DIDP
  - DNOP
Problem PVC Clingwrap

DEHA PLASTICISER

NO PLASTICISERS

Cancer affects us all...
How safe is DEHA?

• 5th April 2011

• STATEMENT ON DEHA AND CANCER BY DR CARL ALBRECHT, HEAD OF RESEARCH, CANSA.

• CANSA is not in favour of DEHA being present in packaging materials such as PVC clingwrap because it can migrate out of the PVC film into food such as minced meat, cheese and chicken. Furthermore this process is accelerated by heating especially in a microwave oven during defrosting (1).

• It is reasonable to suppose that DEHA is entering the food chain and is ending up in human tissue.

• DEHA is not biologically inert. There is evidence that it can increase the expression of the Fatty Acid Transporter (FAT) gene (2). This month it was reported that the FAT protein is elevated in muscle of obese humans (3). This may be related to obesity. Obesity is related to about 15% of cancers (4).

• We conclude that DEHA may be involved in complicated biochemical mechanisms affecting lipid homeostasis and eventually certain cancers.

• We conclude that a reasonable case can be made using the Precautionary Principle (5) to exclude DEHA from any material in contact with food.

• In line with this reasoning CANSA welcomes alternative wrapping materials that do not contain DEHA or any other man-made, synthetic molecule that migrates into food.
Peer-reviewed evidence that DEHA could interfere with fat metabolism

- References:
- Specific migration of di-(2-ethylhexyl) adipate (DEHA) from plasticized PVC film: results from an enforcement campaign, Petersen JH and Breindahl T, Food Addit Contam., 1998, 15, 600-608.
- High muscle lipid content in obesity is not due to enhanced activation of key triglyceride esterification enzymes or the suppression of lipolytic proteins, Li M, Paran C, Wolins, NE and Horowitz JF, Am J Physiol Endocrinol Metab., 2011, 300, 699-707.
DEHA can switch on fat metabolism genes

DEHA is a PPAR alpha activator

FIG. 2. Peroxisome proliferator specificity for FAT and FATP induction in the liver. NZB mice were fed either a control diet or one containing 0.05% Wy 14,643, 0.5% clofibrate, 2% DEHA or 2% DEHP for 5 days. Total RNA (5 mg) isolated from individual livers was subjected to Northern blot analysis using the cDNAs for FAT, FATP, mAspAT, lipoprotein lipase (LPL), liver fatty acid binding-protein (L-FAB) and a2u-globulin (a2u).
PPAR alpha gene “garden”
Implications

• How can we expose the unknowing, unsuspecting public to chemicals if we don’t know the full impact of these chemicals on living systems?
The Far East are very sensitive to plastisisers - are we?

Hong Kong's Center for Food Safety banned the sale and supply of two Taiwan-made sports drinks beginning Tuesday at noon after detecting excessive plasticizer levels.

Thursday 17th November 2011

The two products will not be allowed to return to stores until their manufacturers come up with certificates to prove that they are not tainted with the chemical DEHP.

Heston Kwong Assistant Director of Hong Kong's Department of Health (left) and a food safety inspector.

As the food safety panic worsens in Taiwan, the panic has also extended to mainland China, where Taiwanese food products and restaurants enjoy widespread popularity.
Where are phthalates found?

Where are phthalates found? "Many consumer products contain phthalates. Among these products are vinyl flooring; adhesives; detergents; lubricating oils; solvents; automotive plastics; plastic clothing, such as raincoats; and personal-care products such as soap, shampoo, deodorants, fragrances, hair spray, nail polish; and some medical pharmaceuticals. Phthalates are widely used in flexible polyvinyl chloride plastics, such as plastic bags, garden hoses, inflatable recreational toys, blood-storage bags, intravenous medical tubing and children's toys."
Legislation against baby polycarbonate bottles

The Baby Bottle seems so innocent!

GO BPA FREE™ BABY BOTTLE SAMPLER

Cancer affects us all...
Effect of a low dose of BPA on breast tissue

Control milk duct in mouse breast tissue

Mice treated with 25 ng BPA/kg body weight per day

25 ng is 1000-times lower than the FDA safety limit of 25 ug.

Cancer affects us all...
BABY BOTTLE BANNED

BPA-Baby bottles banned in Canada, Denmark, France, EU, China, South Africa (22-10-2011)

Say NO to BPA!

Cancer affects us all...
Man made chemicals are the last big piece in the cancer causation puzzle

- More than 80,000 in circulation
- Very few tested
- 100’s are hormone disruptors
- 219 in human blood
- Takes decades to cause pathology
Significance of the banning of the baby bottle

- The worldwide banning of the polycarbonate (PCNo.7) baby bottle is a highly significant signal.
- **Consumers**, retailers, scientists, legislators and the media are saying to producers of shoddy products:
  - "**Clean up your act. We will no longer tolerate products that are a threat to our wellbeing. We will ban them.**"
Take home messages

• Cancer is the leading cause of death
• Cancer is caused by carcinogens
• Certain plastics or components have been banned (BPA-PC baby bottles, 6 plasticisers).
• Most plastics are safe (PE, PP)
• Plastics should not be heated near food.
• Banning the PC baby bottle has set the scene for the future
Evidence based
• Cancer risk reduction
• Investigated and approved by CANSA
• Recognised by DOH
CANCER aFFECTS US ALL...
Prevention better than cure: Motsoaledi

South Africa's healthcare model needs to shift from being "hospi-centric" to more preventative if the country is to win the fight against the burden of diseases, Health Minister Aaron Motsoaledi says.

Apr 29, 2011 11:53 AM | By Sapa
• Prevention is the cure of cancer.

Intellectuals solve problems; geniuses prevent them.

Albert Einstein
Thank You