Do we need to include pheromone and kairomone disruption in environmental risk assessment of chemicals?

Henrik Kylin

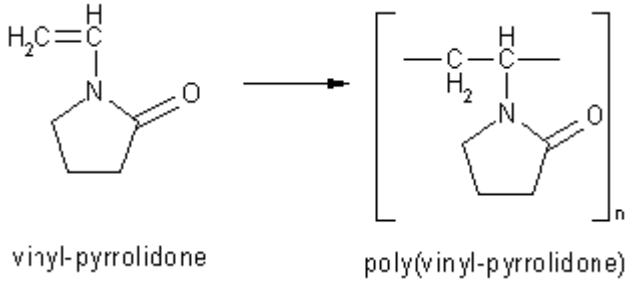
Nor Inst Air Res
Tromsø, Norway

Dept Aqua Sci & Assess
Swed Univ Agric Sci
Uppsala, Sweden

- Pheromones – signaling between individuals of the same species
- Kairomones – signaling between individuals of different species
- More general – infochemicals
- Important for the function of the ecosystem

Polyvinylpyrrolidone - PVP

Suggested as bulk in fish feed



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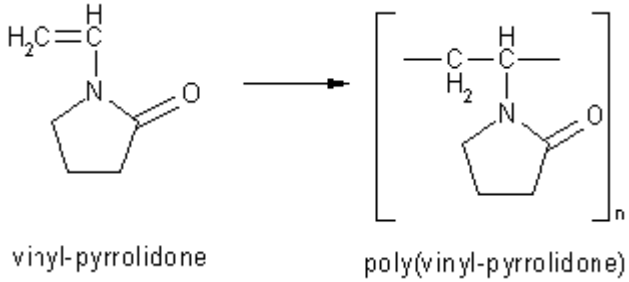

- Not bioavailable – passes through the gut unchanged

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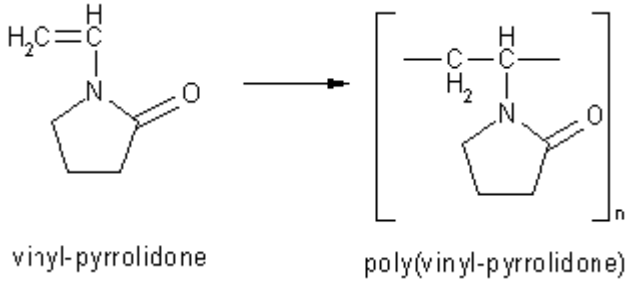

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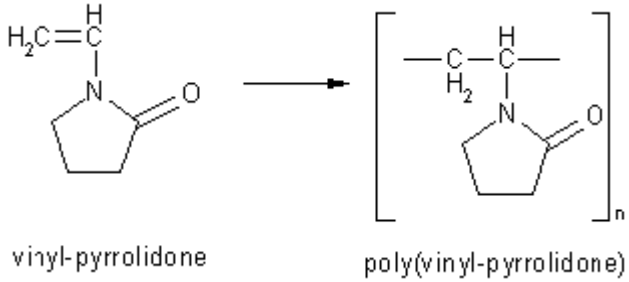

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- Persistent – very slow microbial and abiotic degradation in the aquatic environment

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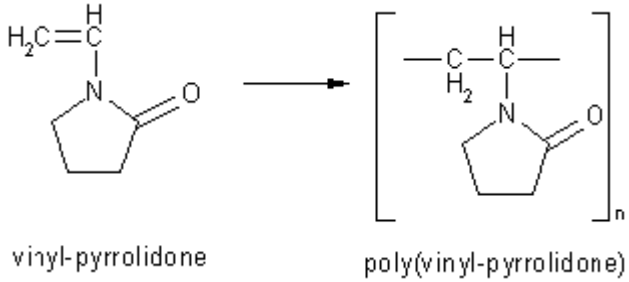

- Not bioavailable – passes through the gut unchanged
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- Persistent – very slow microbial and abiotic degradation in the aquatic environment
- Used in pharmaceuticals and foods

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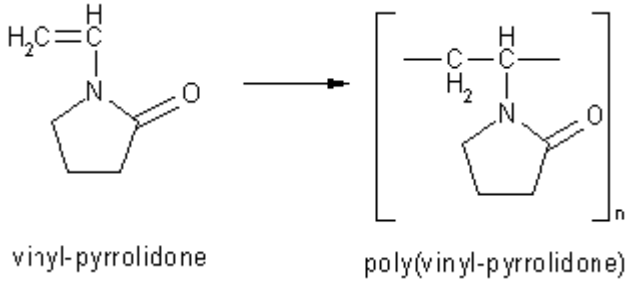

- Persistent – very slow microbial and abiotic degradation in the aquatic environment
- Used to sequester polar chemicals, e.g., phenolics

Polyvinylpyrrolidone - PVP

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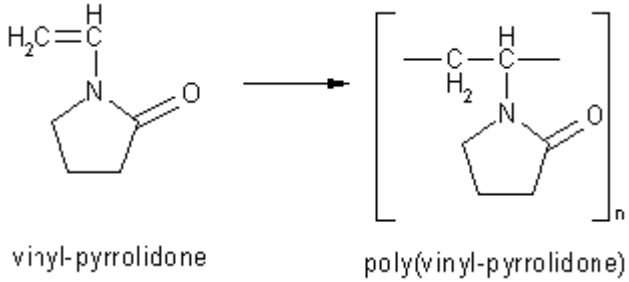

- Can we allow the emission of a compound that sequesters phenolics directly into an ecosystem, the *Fucus*-belt of secluded bays in the Baltic Sea, where phenolics play an important role as infochemical?

Polyvinylpyrrolidone - PVP

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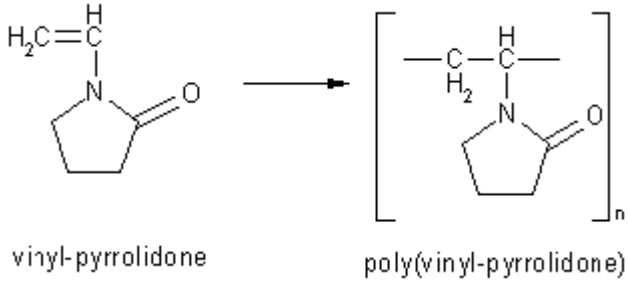

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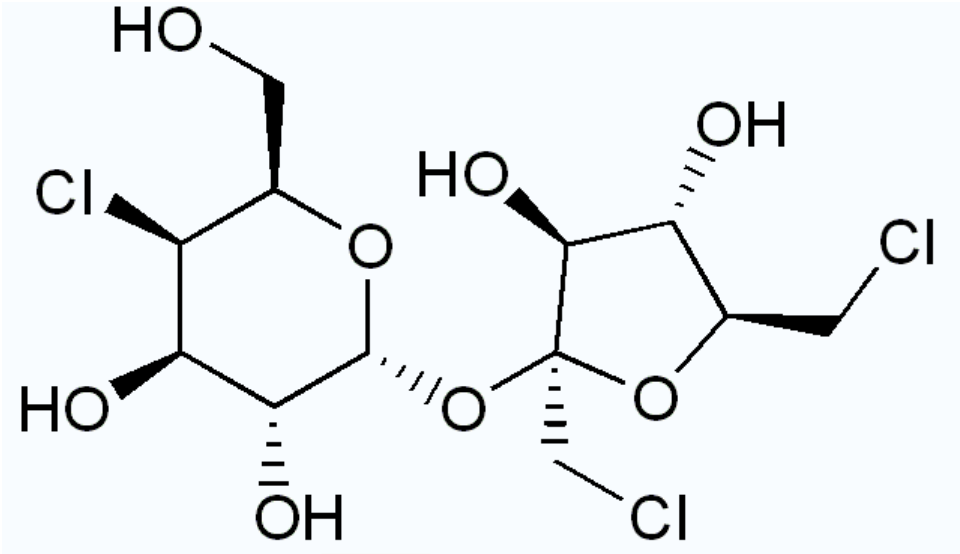
Toth, G.B, Pavia, H. (2001) Removal of dissolved brown algal phlorotannins... J. Chem. Ecol. 27:1899-1910

Sucralose



Trichlorogalactosucrose - TGS

Introduction: A new sweetener in the European food market in 2005

Sukkerforbruket må ned!

Ernæringsspesialistene sloss så føyka står om hva som er farligst av fett eller karbohydrater, men en ting er de i hvert fall enige om - sukkerforbruket må ned. Nå har kanskje løsningen kommet...

Det høye sukkerforbruket i Norge bekymrer alle som er opptatt av helse. Vi blir derfor oppfordret til å redusere inntaket av usunt fett, salt og sukker, samt å spise mer frukt, grønt og fiber. Undersøkelser viser at norske tenåringer spiser nesten dobbelt så mye sukker som verdens helseorganisasjon og norske myndigheter anbefaler.

Alvorlige helseskader

Høyt sukkerinntak kan bidra til helseskader som diabetes og tannsykdommer, og er også en viktig årsak til overvekt. Overvekt er et økende og alvorlig problem som kan føre til alvorlige sykdommer som hjerte- og karsykdommer, diabetes, enkelte former for kreft, muskel- og skjelettplagen, samt psykiske problemer. De siste årene har flere studier vist at

Driving force:
Experts recommend reduced sugar intake.

Supersukker klar for norske ganer

Et nytt supersukker er nå godkjent til bruk i Norge. Flere produsenter står i kø for å l godsaker med det nye vidunderet, og noen har allerede tøystartet.

MAY BRITT BRØYN

Sukralose er søtstoffet som gir naturlig søtsmak uten å gi en eneste kalori. Som tåler både varme og kulde, og kan erstatte sukker i de aller fleste søte produkter. I USA har det vært i bruk i flere år allerede, og i EU har det vært godkjent tilsetningsstoff de siste par årene. Nå er "supersukkeret" godkjent i Norge, og allerede på vei inn i norske butikkhyller.

I følge produsenten er det nærmest ikke grenser for hva sukralose kan brukes til. Det kan erstatte sukker i en lang rekke produkter, som kjeks, kaker, desserter, frokostblandinger, supper, snacks og godtøy. Men det stopper ikke der. For under merkevarenavnet Splenda selges sukralose også i kilospakninger i USA - og kan brukes hjemme på kjøkkenet i matlagingen - som erstatning for sukker i eksempelvis vafler og kaker.

Offensiv markedsføring.

I følge det anerkjente

Sukralose selges under merkevarenavnet Splenda i USA. (Foto: JAN THOMAS ESPEDAL)

Les mer

Sucralose introduced as the ”super sugar” due to its taste, low calorie content, and cooking properties.

Approved in more than 80 countries. Used in food for 20 years in North America.

Emerging issues in Norway and Sweden

Supersukker kan gi kreft

Av Maren Synnevåg, Mozon 22.12.2005 kl. 08:20 Kilde: VG NETT

Det nye supersukkeret sucralose kan være kreftfremkallende, advarer svensk professor. Stoffet brukes i en norsk julebrus.

Søtstoffet har ingen karbohydrater eller kalorier - og er 500 ganger søtere enn sukker, skriver svenske Aftonbladet.

VG Nett følger
Helse og medisin / RSS
Lag din egen RSS

- Det høres uskyldig ut, men deler av sukkermolekylene erstattes med kloratomer i en kjemisk prosess, sier Göran Petersson, professor i kjemisk miljøvitenskap ved Chalmers tekniske høyskole.

Avviser skepsis mot «supersukker»

Coca-Cola prøver ut søtningsstoffet sukralose i Norge, so første land utenfor USA.

Av MAY LINN GJERDING

NY SØTSMAK: Sukralose erstatter søtningsmiddelet aspartam. Foto: Alf Øystein St

Sukralose inneholder omtrent ingen kalorier, men er 600 ganger søtere enn sukker.

Sukralose fremstilles av vanlig

Finn oppskrifter i Matguiden
Søk
Finn drikkevarer i Vinguiden
Søk

- Cola light sukrer havet

Supersukkeret sukralose er vanskelig nedbrytbart, og kan påvirke økosystemet i havet, mener forsker.

HAR DU TIPS? Send NA til 1984 eller epost.

Miljøprofessor Henrik Kylin ved Norsk institutt for
økosystemet i havet kan bli endret som følge av
skriver VG.

Over 400 ulike drikke- og matprodukter i verden,
sukralose, som er kjemisk framstilt og 600 gang

- Stoffet blir ikke tatt opp i kroppen, men i naturen
brytes ned, sier Kylin til VG.

- Ringnes lurer forbruke

MED LITEN SKRIFT: Det er spesielt Imsdal-vannet til Ringnes som opprører IKS og Norges Diabetesforbund.
Foto: Elin Davidsen/ Dagbladet.no

Imsdal med smak inneholder kunstige søtningstoffer som lurer kroppen til å produsere insulin.

annonse

annonse

LES OGSÅ:
- helse
- Mattilsynet sjekker krydderimportør
- I mors øyne er du aldri tjukk
- Aftenposten tøvset med Gilde

Main arguments:

- **Maybe carcinogenic**
- **Registration process not correct**
- **Environmental effects not understood**

Arguments probably much due to lack of open access to data

Registration process

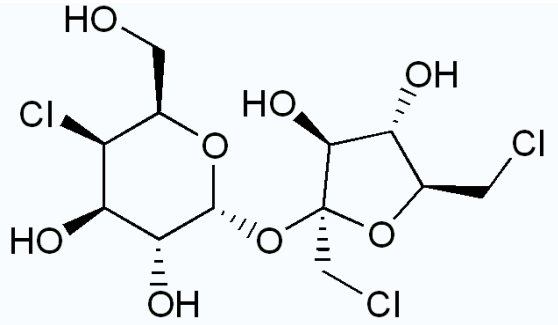
- Registration HAS followed all regulations
- No environmental risk assessment needed for food additives. "If it's safe for humans there's no risk to the environment"
- Initially, neither food safety nor environmental agencies recognized potential problems; problems fall between chairs
- Standard toxicity tests (LC_{50}) on aquatic organisms have been performed to check problems with sewage effluents
- Based on the standard toxicity tests, some environmental agencies dismissed environmental problems
- Based on the hydrophilicity some environmental agencies concluded that sucralose will be easily degradable in sewage treatment plants
- Doubtful if sucralose would have been stopped even if an environmental risk assessment had been compulsory

Old thinking in the registration process

Persistence is beneficial!

The solution to pollution is dilution

Comparison of sweeteners



Sucralose

Molecular formula: $C_{12}H_{19}Cl_3O_8$

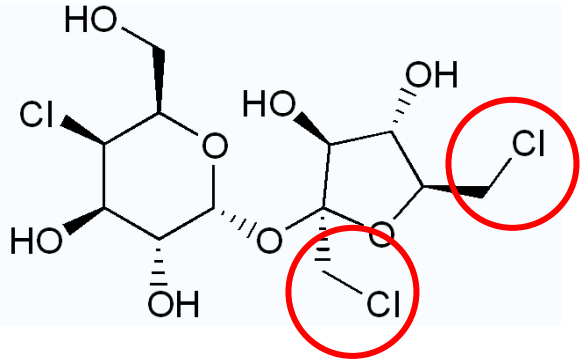
- **Cyclamate (E952): 25-30 times**
- **Acesulfam K (E950): 130-200 times**
- **Aspartam (E951): 200 times**
- **Saccharin (E954) : 300 times**
- **Sucralose (E955): 500-600 times**

Sweetness compared with sucrose

- **Cyclamate: 7 mg/kg body weight**
- **Acesulfam K: 9 mg/kg body weight**
- **Aspartam: 40 mg/kg body weight**
- **Saccharin: 5 mg/kg body weight**
- **Sucralose: 15 mg/kg body weight**

ADI

Sucralose properties



First impression:

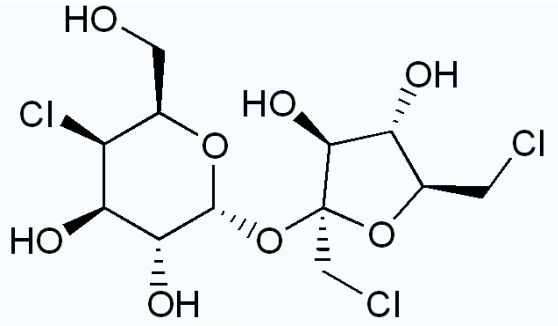
Sucralose has two –CH_2Cl groups that should be very reactive

→ **the half-life should be short**

→ **sucralose could be mutagenic, maybe even carcinogenic**

Both suppositions seem to be wrong!

Environmental fate

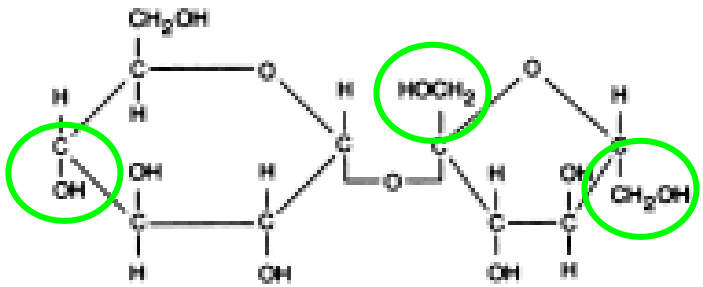


- **Sucralose is very hydrophilic (log K_{OW}= -0.8)**
  → **Bioaccumulation will not be a problem**

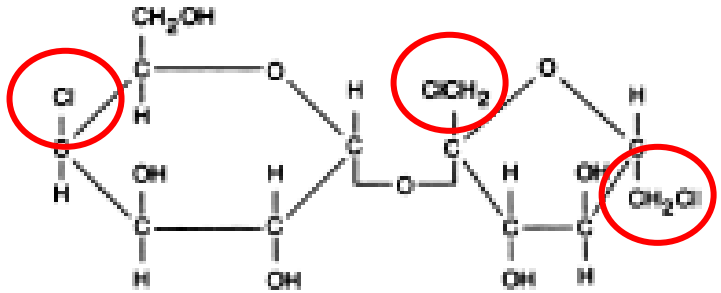
- **Degradation pathways in the environment are unclear. No microbe can use sucralose as sole carbon source. Observed degradation takes place by co-metabolism that requires a mix of different unidentified microbes and a separate carbon source.**
- **Half-life in soils/sediment seems to be short (a few weeks).**
- **No photodegradation**
- **Half-life in water is VERY long (at 25 °C: >3 years at pH 3 and 7, >1 year at pH 9) and should be even longer in cold climates.**

Sucralose WILL stay dissolved in the water!

Sucralose structure and hydrolysis products

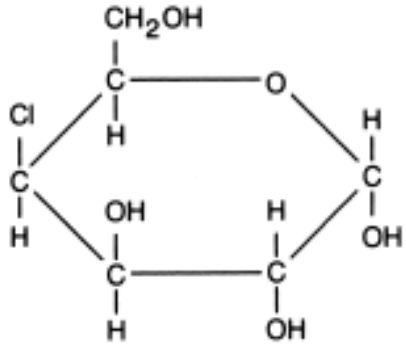


Sucrose



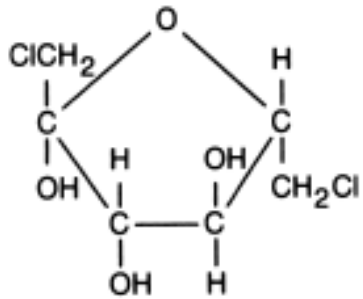
Sucralose

H^+, H_2O



4-chloro-4-deoxy-D-galactose

+



1,6-dichloro-1,6-dideoxy-D-fructose

In Humans

98 % excreted as native sucralose

==========

15 % is taken up

85 % excreted as native sucralose via faeces

13 % excreted as native sucralose via urine

2 % excreted as degradation products via urine (the two monosaccharides and various conjugates)

(Ref: Tate & Lyle)

Conclusion from screening in Norway

- **Essentially all sucralose that reaches the Norwegian consumers will be found in the effluent from sewage treatment plants and reach recipient waters**

Environmental Effects?

- **Sucralose inhibits the transport of sucrose in sugar cane** (Reinders et al. (2006) Plant Cell Environ 29:1871-1880)
- **No other environmental effects known. No one has looked!**
- **Sucralose has at least one biological effect: Sweetness**
- **Other chlorinated sugars have various effects on the receptors for sweetness, increasing or blocking responses to sweet taste in experimental animals. Interspecific variation large → difficult to predict effects on olfactory mediated behaviours in "non-target organisms"**
- **What of effects on other physiological functions in which sucrose plays a role?**

What if sucralose...

…inhibits sucrose transport in all aquatic vascular plants, e.g., reed, rice?

…alters gene expression in plants?

…acts as feeding cue, triggering undue feeding behaviour in, e.g., zooplakton?

…affects signals between symbionts in, e.g., corals?

…affects orientation in migrating fish?

…

Questions Arising

- Sucralose will not bioaccumulate and gives no alarming response in traditional toxicity (mortality) tests. Does that mean there are no environmental risks?
- For compounds that mimic biologically active compounds, perhaps interruptions of the physiological function of the native compound must be tested while toxicity is of less importance?
- Should persistence in itself be a sufficient criterion to ban a substance?

Questions arising

- Should bioactivity replace bioaccumulation in the PBT criteria of the Stockholm Convention?
- Do we need to define and include infochemical disruptors (pheromones, kairomones, ...) for environmental testing?

Ongoing work

- Project to look at possible effects of sucralose in a broad ecological framework funded by Norwegian Research Council after screening results in Norway and Sweden
- All suggestions welcome!