Potentially health promoting phytochemicals of the benzoxazinoid group (BXs) are abundant in cereal grains and food products

Potential conflict of interest

- Out of project funding of a total of 3 mill € in this research area 2010-2017, 13% came from industry
- I am co-inventor of a patent application EP 2 265 133 A1 (patent was not granted)

Which plants contain BX compounds?

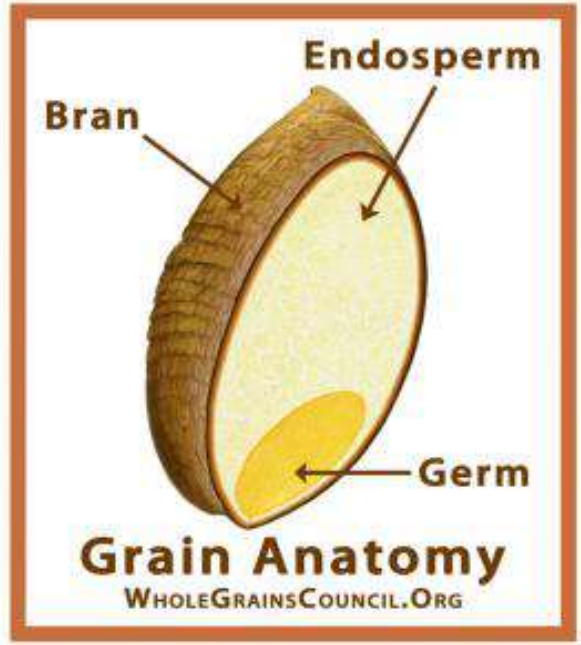
Eng: rye
Sp: centeno
La: *Secale cereale*

!!Not to be confounded with ryegrass, used for lawns and pasture!! *(Lolium perenne)*

Monocots; of the grass family (Poaceae)
Important agricultural crops

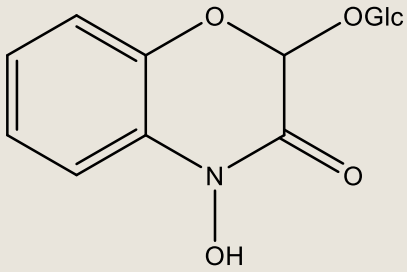
Grain anatomy

- Benzoxazinoids and other bioactive small molecules are mainly found in bran and germ

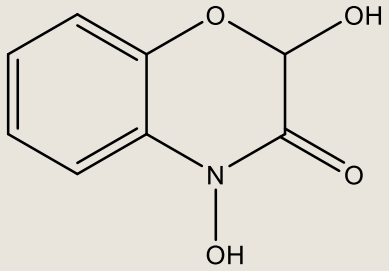


With permission WholeGrainsCouncil

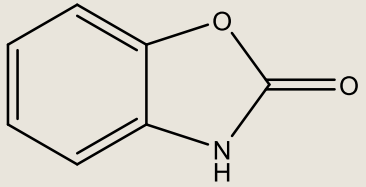
Structures, examples



DIBOA-Glc



DIBOA



BOA

Which other plants contain BX compounds?

Dicots, several plant families
Traditional medicinal plants

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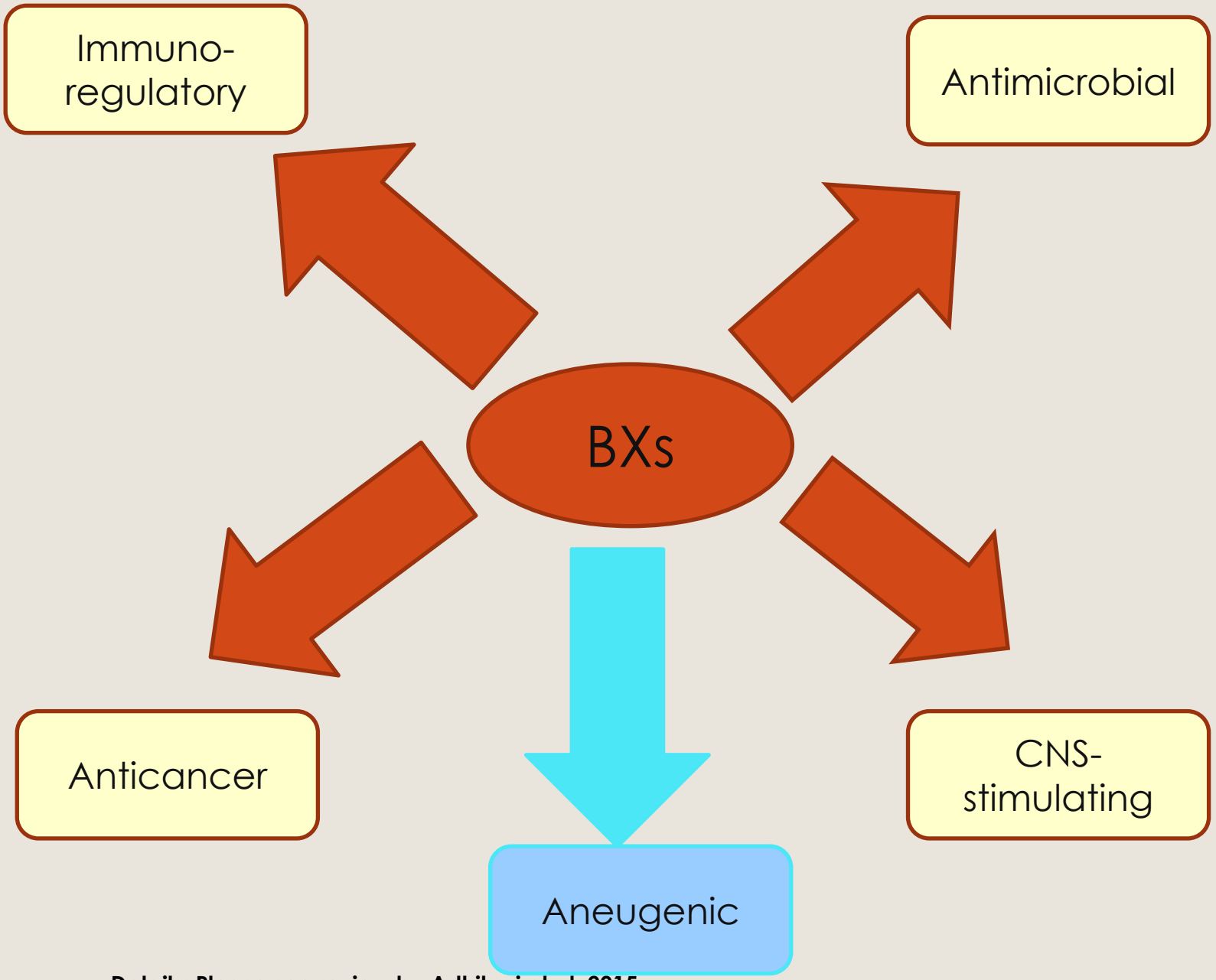
Literature review



Details: Please see review by Adhikari et al, 2015.

Uptake, circulation in plasma and excretion

- Intact BXs and their conjugates appeared in plasma and in urine of rats, pigs and humans.
- Possible distribution of BXs into different tissues.
- APO* in urine, bile, and faeces of mammals

Adhikari et al, JAFC **2012a**,
Adhikari et al, JAFC, **2012b**,
Adhikari et al, Mol. Nutr. Food Res. **2013**
Jensen et al, *Eur J Nutr* **2017**

*2-aminophenoxazinone

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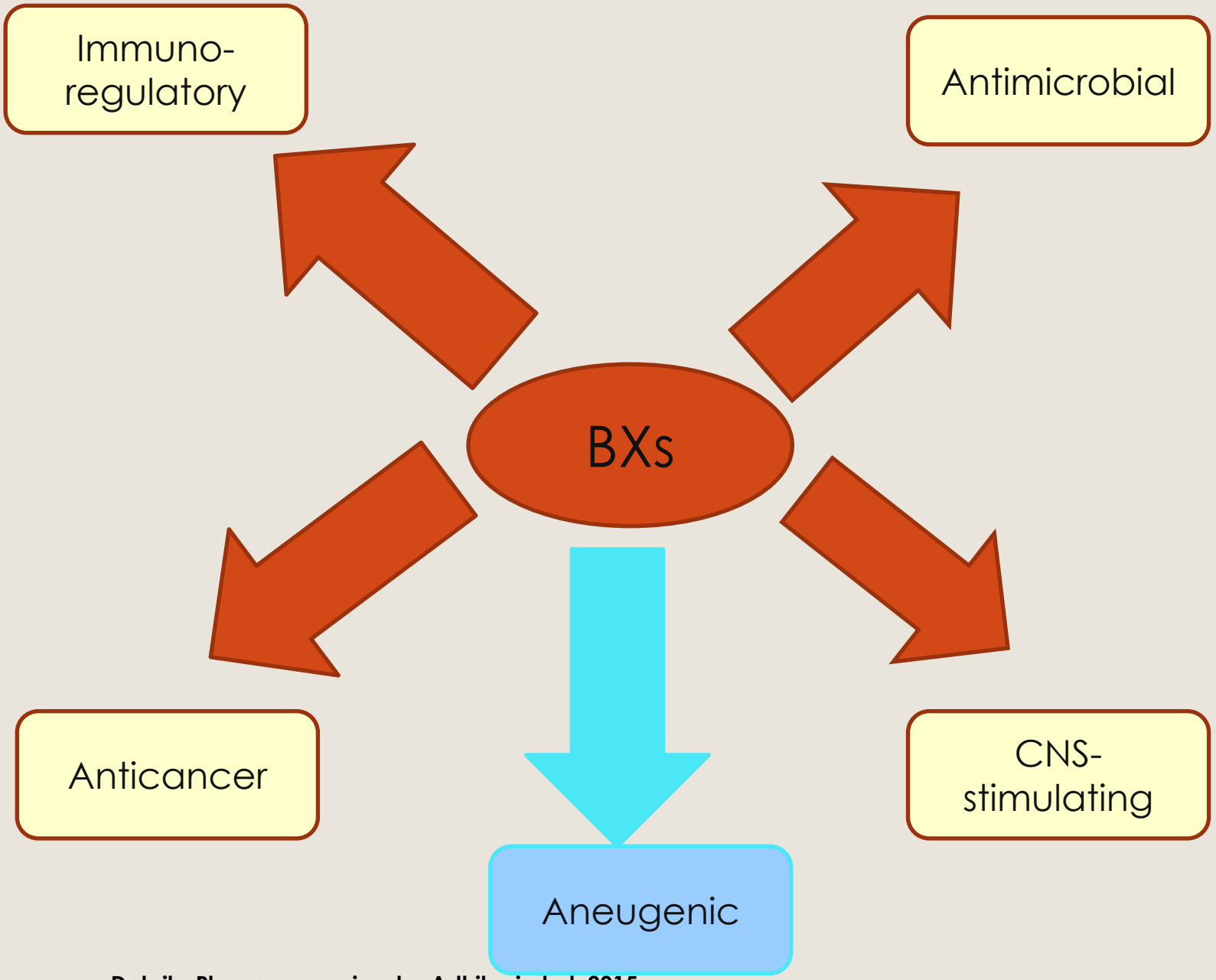
Literature review



Details: Please see review by Adhikari et al, 2015.

Immuno-regulation

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- Bacteria induce immune response in innate immune cells
- A previous whole-grain high-BX, high rye, diet resulted in an enhancement of this immune response (*ex-vivo* study).

Damgaard et al, Mol. Nutr. Food Res, **2015**

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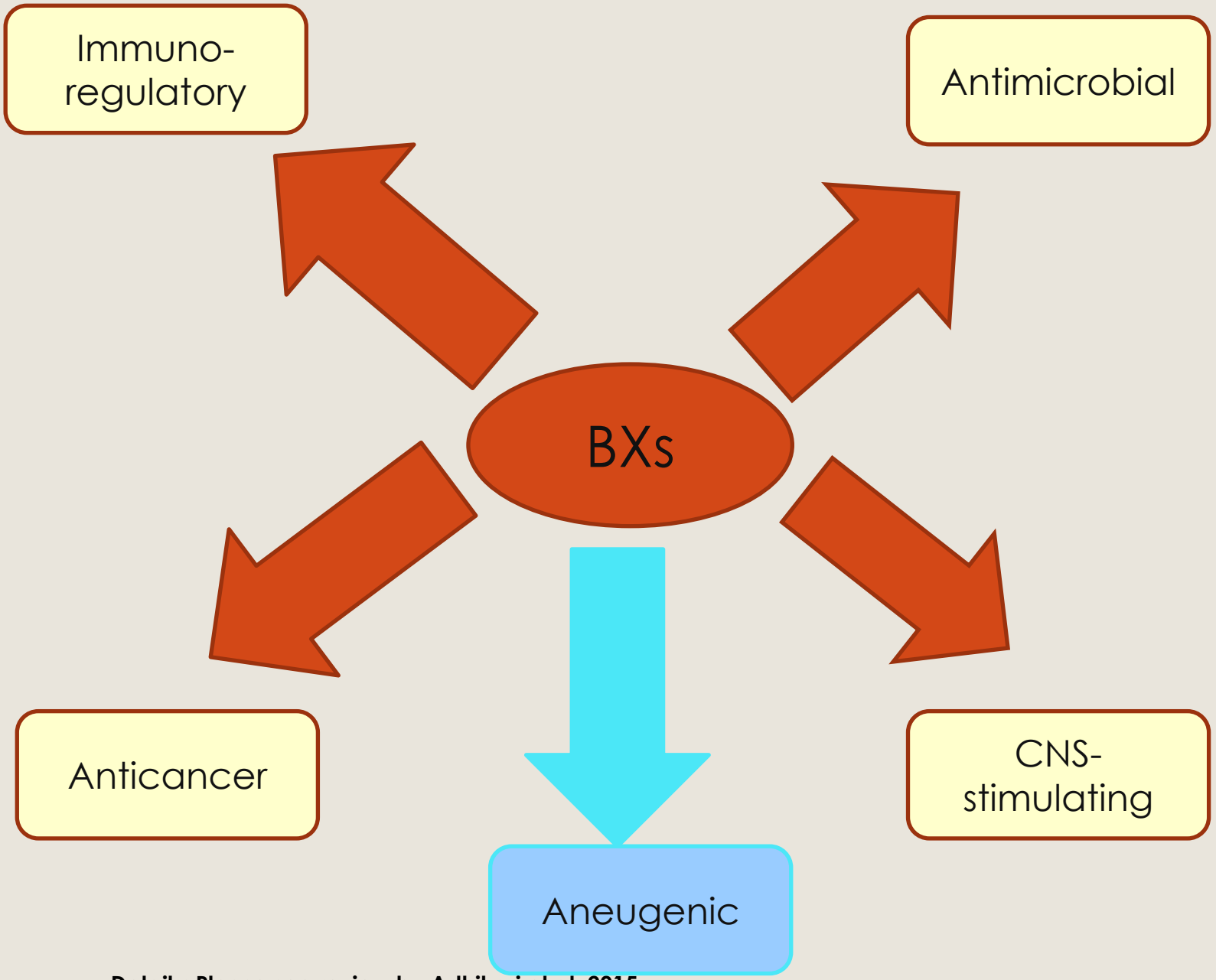
Literature review



Details: Please see review by Adhikari et al, 2015.

Background: Anticancer – human intervention

- Humans with prostate cancer: lower PSA in **rye whole grain and bran** intervention group (Landberg et al, 2010)
- Which constituents caused the effects?

Background: Anticancer – animal studies

- **Rye bran** fed to transplanted mice: delayed prostate tumor growth and increased tumor cell apoptosis (Bylund et al, 2000)
- **Rye bran** diet increased epithelial cell apoptosis in prostate tumors in transgenic mice (Wikström et al, 2009)
- Which constituents caused the effects?

Benzoxazinoids – uptake in prostate tissue after one week diet

- Prostate tissue: 7 benzoxazinoid compounds detected ranging from 0.2 to 10.6 ng/g tissue
- Prostate tissue: High variation between patients

Steffensen et al, 2016, JAFC.

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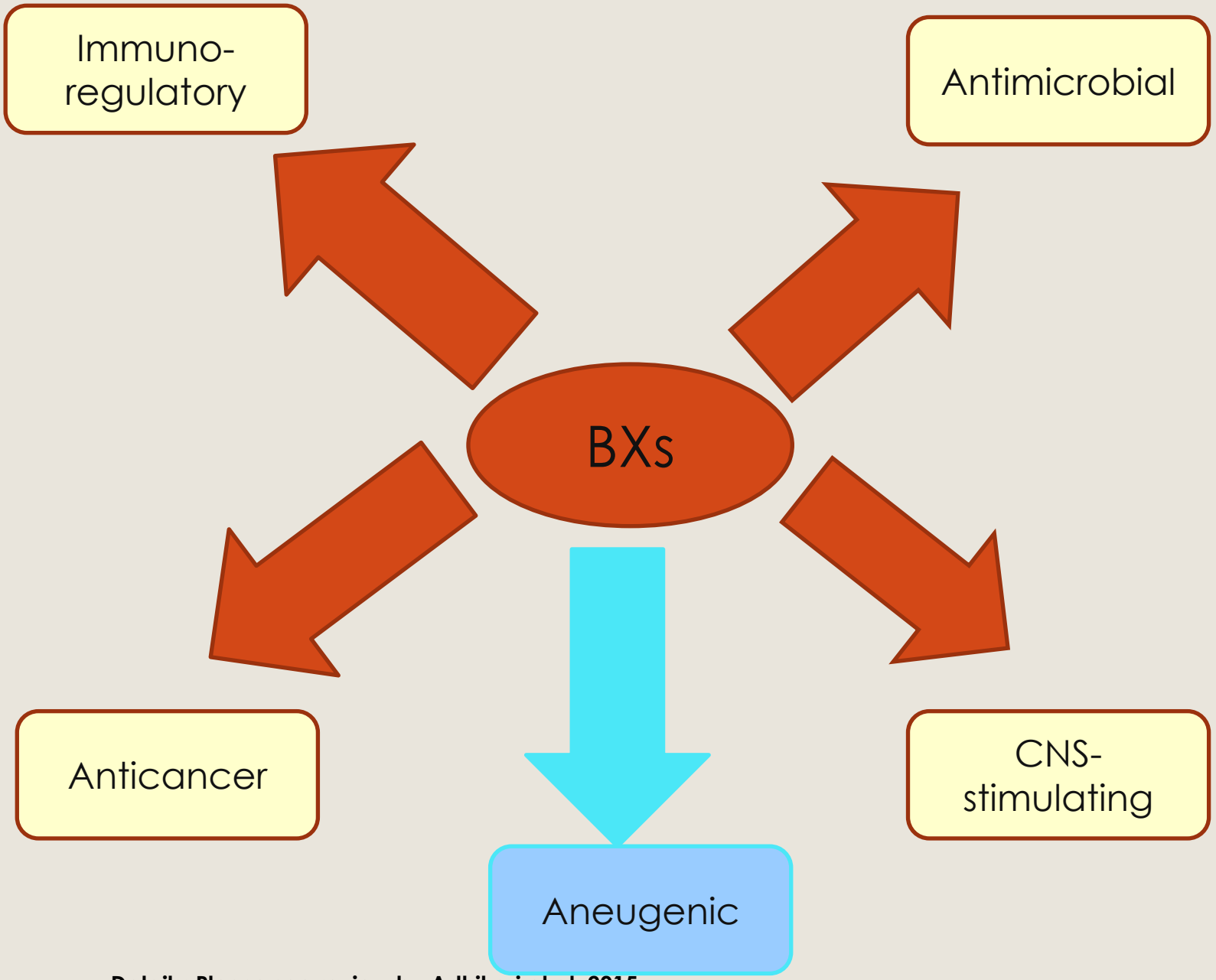
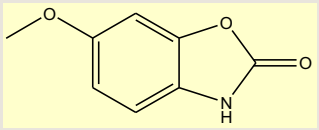
Literature review



Details: Please see review by Adhikari et al, 2015

CNS-stimulating effects of MBOA?



MBOA

⇒ Patent, Rosenfeld et al, US 6,667,308, Dec. 2003

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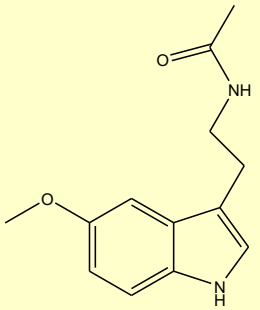
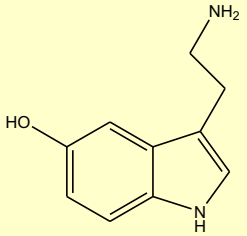
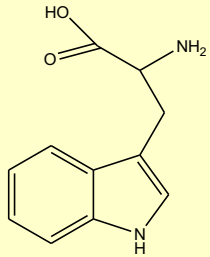


melatonin



serotonin



tryptophan

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Technological processes for potentially optimizing BX content

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Proof of concept project ; Danish Ministry of Research, 2010-2011

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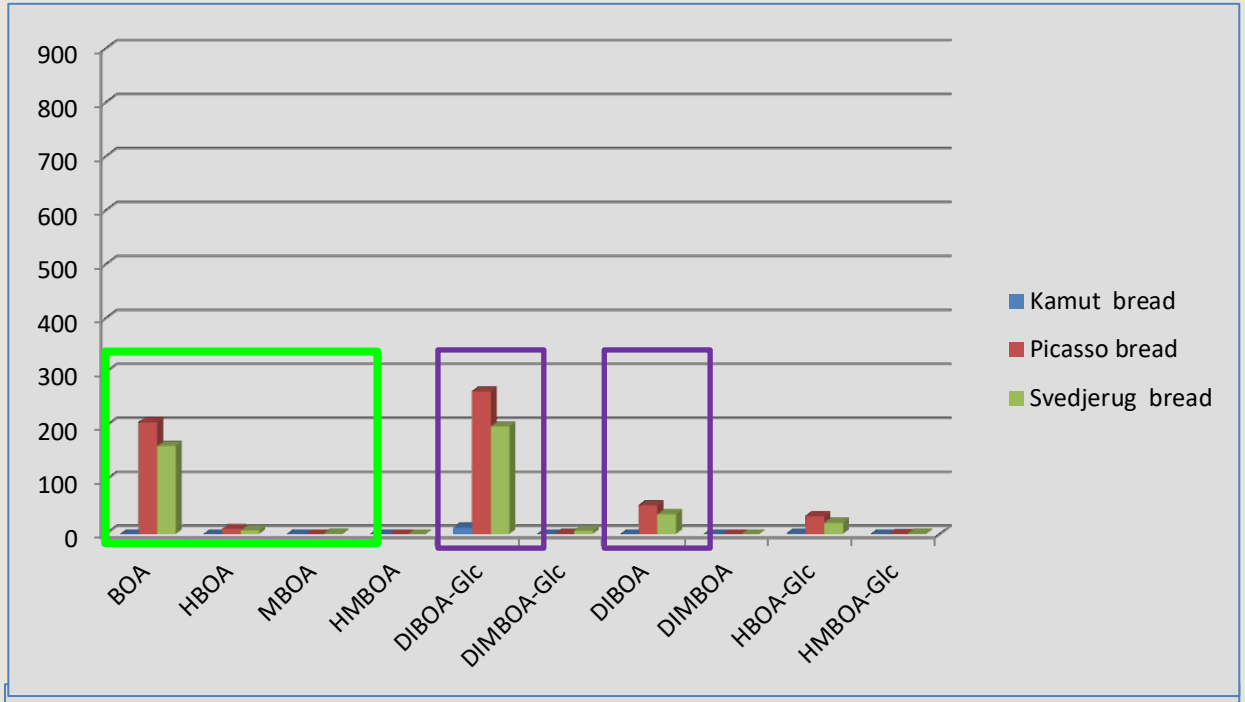
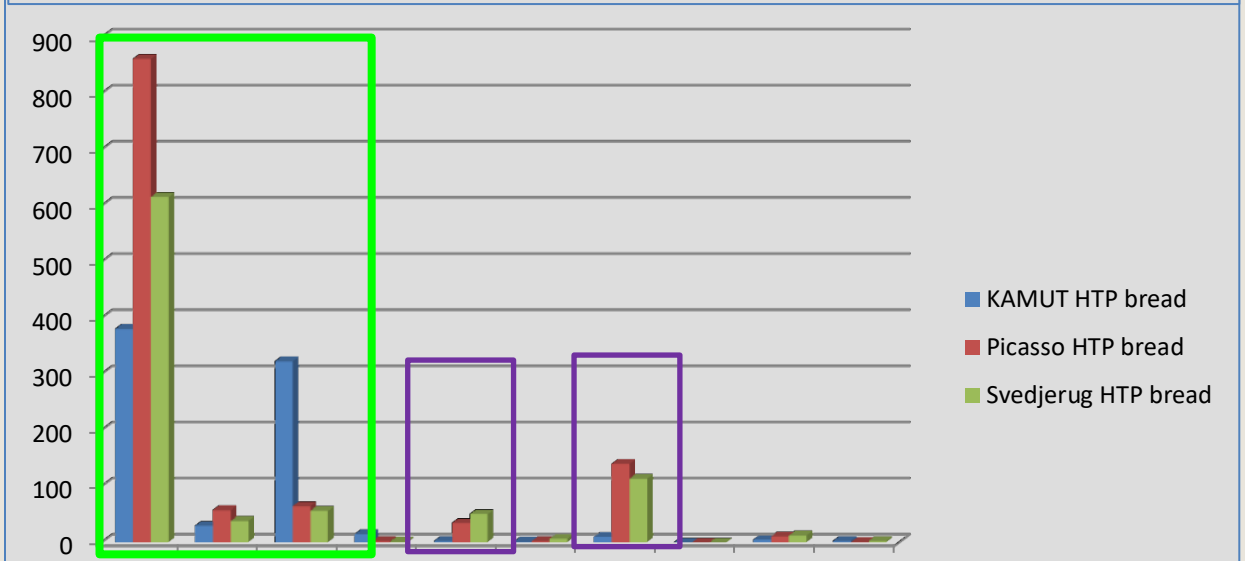
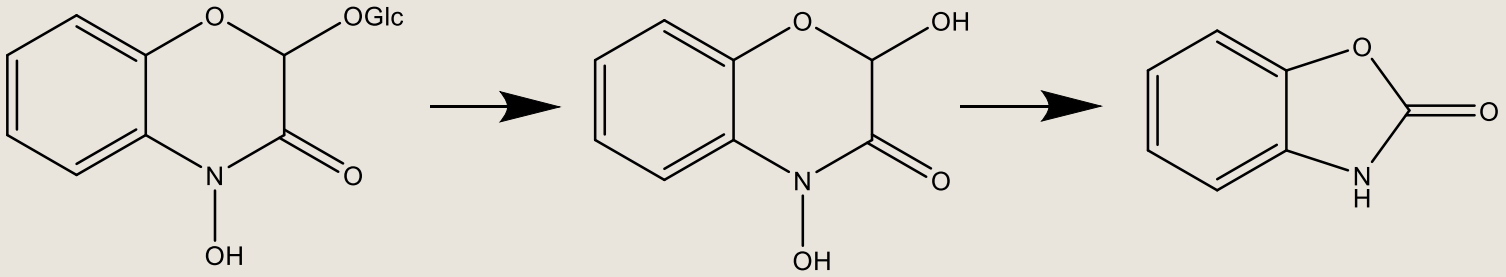
Normal vs HTP baking, nmol/g DW





Pedersen et al, 2011,
Food Chemistry

Structures, examples



DIBOA-Glc DIBOA BOA

Other processes that enhance and change BX content

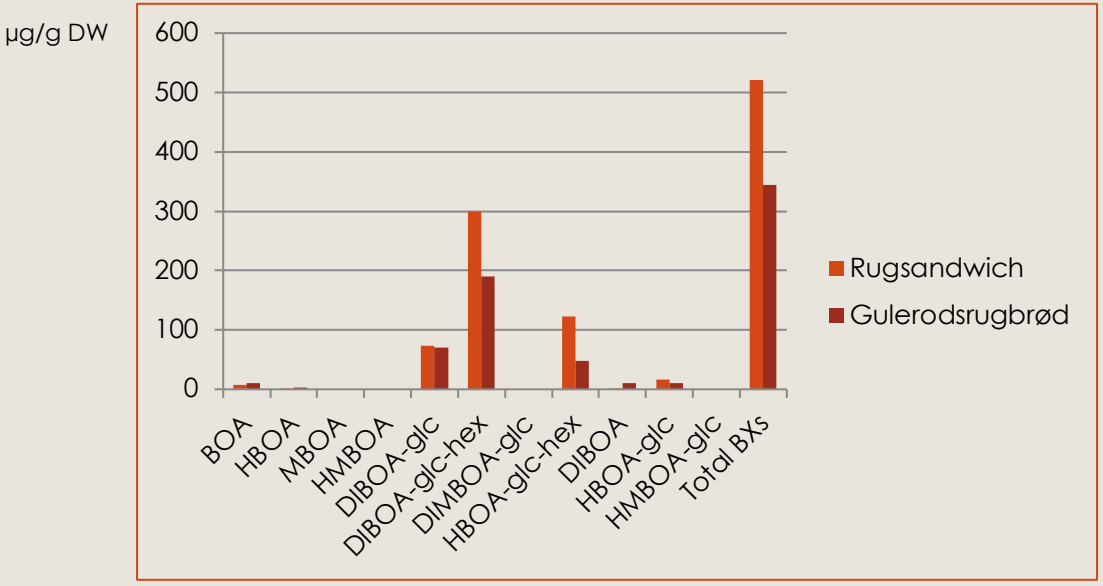
- Malting
- Fermentation
- Vapor treatment

Tanwir et al, Food Chem. 2013
Tanwir et al, Phytochemistry, 2017

BXs in commercially available cereal food

Rye sandwich
2 slices: 16 mg BXs

Carrot **rye**bread
2 slices: 10 mg BXs



Steffensen et al, JFCA, 2017

Needs in future work

- Full characterization of structures
- Methods for easy isolation
- Fate in the body – distribution to tissues
- Effect studies that include mechanisms

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Thanks for listening! Questions or comments?

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