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INP

NATURALLY INFORMED  
Approved by Abbott Nutrition, Ingredion and Health Transformation Center

**MICROBIOME:  
Mastering the Market**

Immunomodulatory effect of  
graminan-type fructans  
from Agave plant via  
Toll-like receptors

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GLOBAL  
**PREBIOTIC**  
ASSOCIATION

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Economic, technological and social changes nowadays have influenced lifestyle and feeding habits, being the **scarce inclusion of fiber in the diet** one of the main factors impacting on population health.

Sedentary lifestyle

Feeding habits

RISK ↑  
**Obesity  
Metabolic syndrome  
Diabetes  
Cardiovascular disease**

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The beneficial health effects of consuming dietary fiber include:

Improvement of the odds for successful aging

Less than 10% of most Western populations consume adequate levels of whole fruits and dietary fiber with typical intake being about half of the recommended levels.

Shihler M. Nutrients. 2018;10(12): 411: E1833.  
Food and Agriculture Organization of the United Nations, UNICEF, The Institute for Health Metrics and Evaluation (IHME)  
López-Olmedo, et al. J Nutr 2016;146(9):1856-65S.

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### What is fiber?

- > Dietary fibers are carbohydrate polymers naturally found in fruits, vegetables and plants, obtained by physical, enzymatic or chemical methods.
- > Cannot be hydrolyzed by endogenous human's enzymes.
- > Are the primary source of carbohydrates for microbiota, whose fermentation products are short chain fatty acids.
- > Among this fibers are inulin-type fructans.
- > Fructans have been studied in the last decades due to their potential benefits to health

Cummings JH, et al. Lancet 2009;374(9683):28

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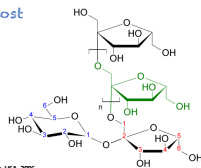
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### Inulin-type fructans

- ❖ Energy reserve carbohydrates present in more than 36,000 plant species.
- ❖ Isolated for the first time in 1804, from the species *Inula helenium*.
- ❖ Their beta configuration prevents them to be hydrolyzed by saliva and intestinal human digestive enzymes
- ❖ Inulin from chicory plant is one of the most common fibers in Europe.



Frank A. Inulin. In: Stephen AM, Phillips GD, Williams PA (Eds). Food polysaccharides and their applications. Taylor & Francis Group, Florida, USA, 2006.

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### Chicory fructans are widely used in Europe

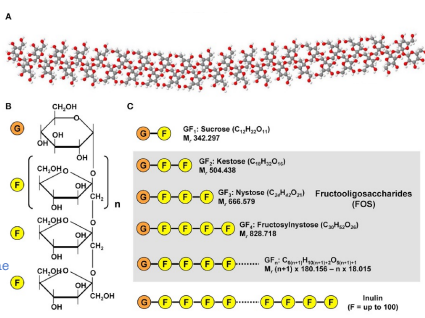


Also known as "*inulins*".

$\beta(2 \rightarrow 1)$  bonds

Linear structure.

Have demonstrated to protect the intestinal barrier, however the underlying mechanisms are not completely elucidated.



Vogt, et al. J Nutr 2014;144:1002-1008; Lambertz, et al. Front Immunol 2017;8:1159

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**Agave fructans (agavins) are widely used in Latin America**

$\beta(2\rightarrow1)$  and  $\beta(2\rightarrow6)$  bonds.

Graminan-type fructans

Elongation in three directions

They also contain structures of the neoserine type.

Branched structure.

Agavins are the most complex fructan structure described to date

Lopez MG, et al. 2003; Mellado-Mojica, et al. 2012; Pérez-López et al 2020; Franco-Robles, et al. Scientific World Journal. 2015; 2015: 289267.

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**Mexican Agave plant is a source of inulin-type fructans**

**Tequila, mezcal**

*Agave tequiliana* Weber blue variety

López-Romero, et al. J Sci Food Agric. 2018;98(7):2461-2474.

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**Fructans among the non-digestible carbohydrates**

- Their beta configuration prevents them to be hydrolyzed by saliva and intestinal human digestive enzymes.
- "Indirect" beneficial health effect through their fermentation products in colon

- Improvement of gut health
- Reduction of the risk of excessive weight gain and obesity
- Lowering elevated LDL-cholesterol
- Decreasing of cardiovascular disease risk
- Reduction of cancer, stroke and T2DM risk

Improvement of the odds for successful aging

Diabete 2018; Nijssen 2018; 2018:120131; doi:10.1186/s12933-018-0600-0; Lombard, et al. Food Research International. 2012; 45:1155.

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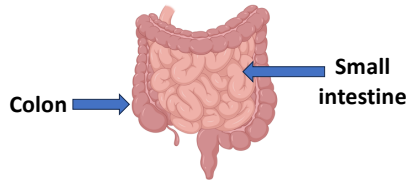
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However, before reaching the colon, fructans get in contact with the small intestine, where they exert a direct effect by interacting with the constituents of the intestinal epithelial cells




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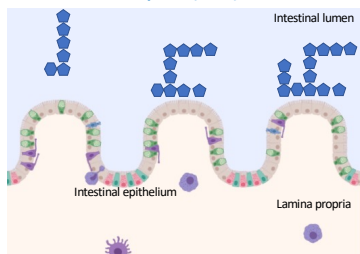
Inulin-type fructans can directly stimulate some of the immune components such as Toll-like receptors (TLRs)

Anti-inflammatory and regulatory effects

Immunomodulatory effect

✓ Fiber-induced crosstalk between IECs, DCs and T cells

✓ TLR signalling



The mechanisms that underly the beneficial health effects of inulins and agave fructans have not been completely elucidated...

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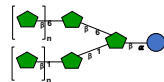
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To investigate the direct immunomodulatory effect of agavin-type fructans *in vitro*

❖ Two different mixtures of fructans extracted from *A. tequilana*:

-Graminan-type fructan I (GTF I): Short branched chain (DP 3 - 7).

-Graminan-type fructan II (GTF II): Long branched chain (DP 3-60).



❖ Two different mixtures of fructans extracted from *C. intybus* :

-Inulin-type fructan I (ITF I): Short linear chain (DP 3 - 10).

-Inulin-type fructan II (ITF II): Long linear chain (DP 10-60).



❖ Their chemical and structural characteristics were also studied.

❖ The effect of linear Vs. branched fructan structures was also investigated.

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Agave fructans inhibit the activation of toll-like receptors, this effect was dependent on the structure of the applied fructan

¿What would it be the potential sites of interaction of agave fructans with TLRs?

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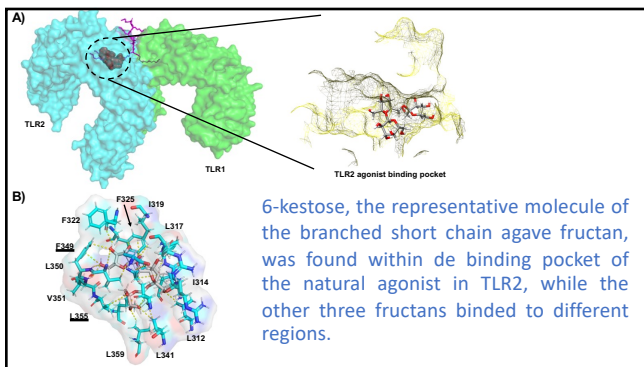
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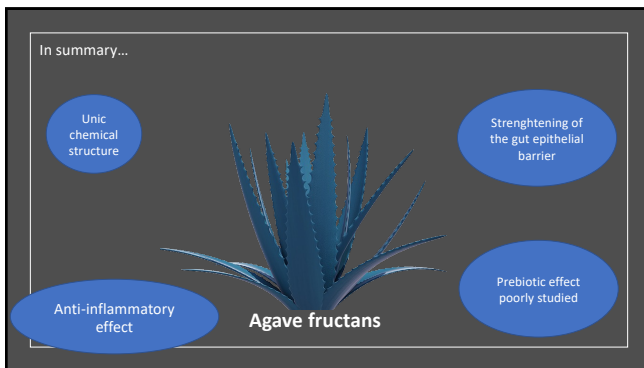
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In summary...



Unic chemical structure  
Strengthening of the gut epithelial barrier  
Anti-inflammatory effect  
Prebiotic effect poorly studied

Agave fructans

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GLOBAL  
**Thank you !** PREBIOTIC  
ASSOCIATION

**Young researcher grant recipient of the 2023 fundamental research award**

Fernández-Lainez, C., Akkerman, R., Oerlemans, M.M.P., Logtenberg, M.J., Schols, H.A., Silva-Lagos, L.A., G. López-Velázquez, G., de Vos, P.  $\beta(2\rightarrow6)$ -Type fructans attenuate proinflammatory responses in a structure dependent fashion via Toll-like receptors. Carbohydr Polym. 2022, <https://doi.org/10.1016/j.carbpol.2021.118893>.

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university of groningen

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Thank you for your attention!

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