# Module 1: Hydrothermal processing to promote micronutrient bioavailability in processed food products

## Introduction to Hydrothermal Process - What is Hydrothermal Process?

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# Hydrothermal processing of whole grains

Whole grains are nutrient rich however, they also contain phytate, an anti-nutrient that limits bioavailability of these micronutrients.

**Hydrothermal technology** is a proven, water and heat-based method to naturally reducing phytate in grains. Hydrothermal process under optimal conditions can reduce the content of phytate up to 90% in different cereals.

By doing this, **bioavailability of micronutrients** such as iron, zinc and calcium among other minerals in grains is increased by up to 400%.

To control that the process has succeeded there is a need for analytical control methods of phytic acid such as HPLC or lower-tech alternatives.

# The hydrothermal process

The process includes different wet and dry steeping steps in order to increase the moisture content in the grains and to activate phytase enzymes that will degrade phytate.

Endogenous phytase activity varies in different types of cereals. By optimising the temperature for the wet and dry steps, and adjusting the pH of the steeping water, the endogenous phytases can be activated to an optimal level.

# Steps

Raw material of whole grain

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Cold water wash

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Wet steep

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Dry steep

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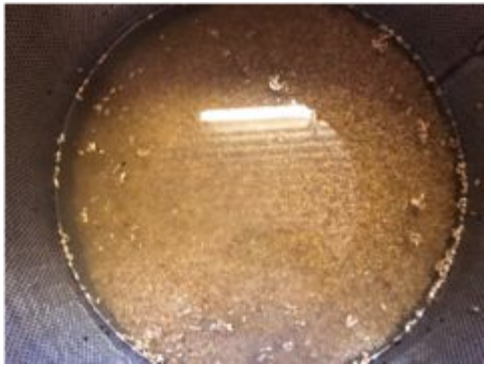
Drying

# The Hydrothermal Process

**Selection of grains-** Select whole grains and when possible, use traditional local varieties that are naturally nutrient-richer.

**Cold water wash-** Wash the raw material in cold water until the water is clear and remove husks or weed floating on the top.

**Wet steep**- The whole kernels of grains are soaked in a superfluity of warm water and with organic acid. The low pH provided by the lactic acid will prevent that the microbes to grow during the rest of the processing.



# The Hydrothermal Process

**Dry steep**- The superfluous fluid is drained off and the whole grains are kept warm in a temperature favourable for phytase activity. Whole grains need to be carefully stirred at intervals.

**Drying**- It can be performed in an oven with high airflow. Preferable use plates that are perforated with small holes.

Drying can be performed at different temperatures to result in products with different taste and textures depending on the final use.

# Read more about hydrothermal process in the following publications:


- K Fredlund, E-L Bergman, L Rossander-Hulthe´n, M Isaksson, A Almgren and A-S Sandberg, Hydrothermal treatment and malting of barley improved zinc absorption but not calcium absorption in humans European Journal of Clinical Nutrition (2003) 57, 1507–1513
- Fredlund K, Asp N-G, Larsson M, et al. Phytate reduction in whole grains of wheat, rye, barley and oats after hydrothermal treatment. J Cereal Sci. 1997;25:83–91
- Nils-Gunnar Carlsson, Eva-Lotta Bergman,* Erika Skoglund, Kristina Hasselblad, and Ann-Sofie Sandberg  Rapid Analysis of Inositol Phosphates J. Agric. Food Chem. 2001 49, 1695-1701
- Sandberg AS, Ahderinne R. HPLC method for determination of inositol tri-, tetrapenta- and hexaphosphates in foods and intestinal contents J Food Sci. 1986;51:547–550.
- Skoglund E, Carlsson NG, Sandberg AS. Determination of isomers of inositol mono- to hexaphosphates in selected foods and intestinal contents using high performance ion chromatography. J Agric Food Chem. 1997;45:431–436.
- Rosalind S. Gibson, Victor Raboy and Janet C. King. Lead Article: Implications of phytate in plant-based foods for iron and zinc bioavailability, setting dietary requirements, and formulating programs and policies. Nutrition Reviews VR Vol. 76(11):793–804
- Schlemmer U, Frølich W, Prieto RM, et al. Phytate in foods and significance for humans: food sources, intake, processing, bioavailability, protective role and analysis. Mol Nutr Food Res. 2009;53:S330–S375.