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Processing of the non-starch polysaccharides of wheat for the optimization of their functional and nutritional characteristics.

Traitement de la fraction des polysaccharides non amylacés de blé pour l'optimisation de leurs caractéristiques fonctionnelles et nutritionnelles.

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Introduction

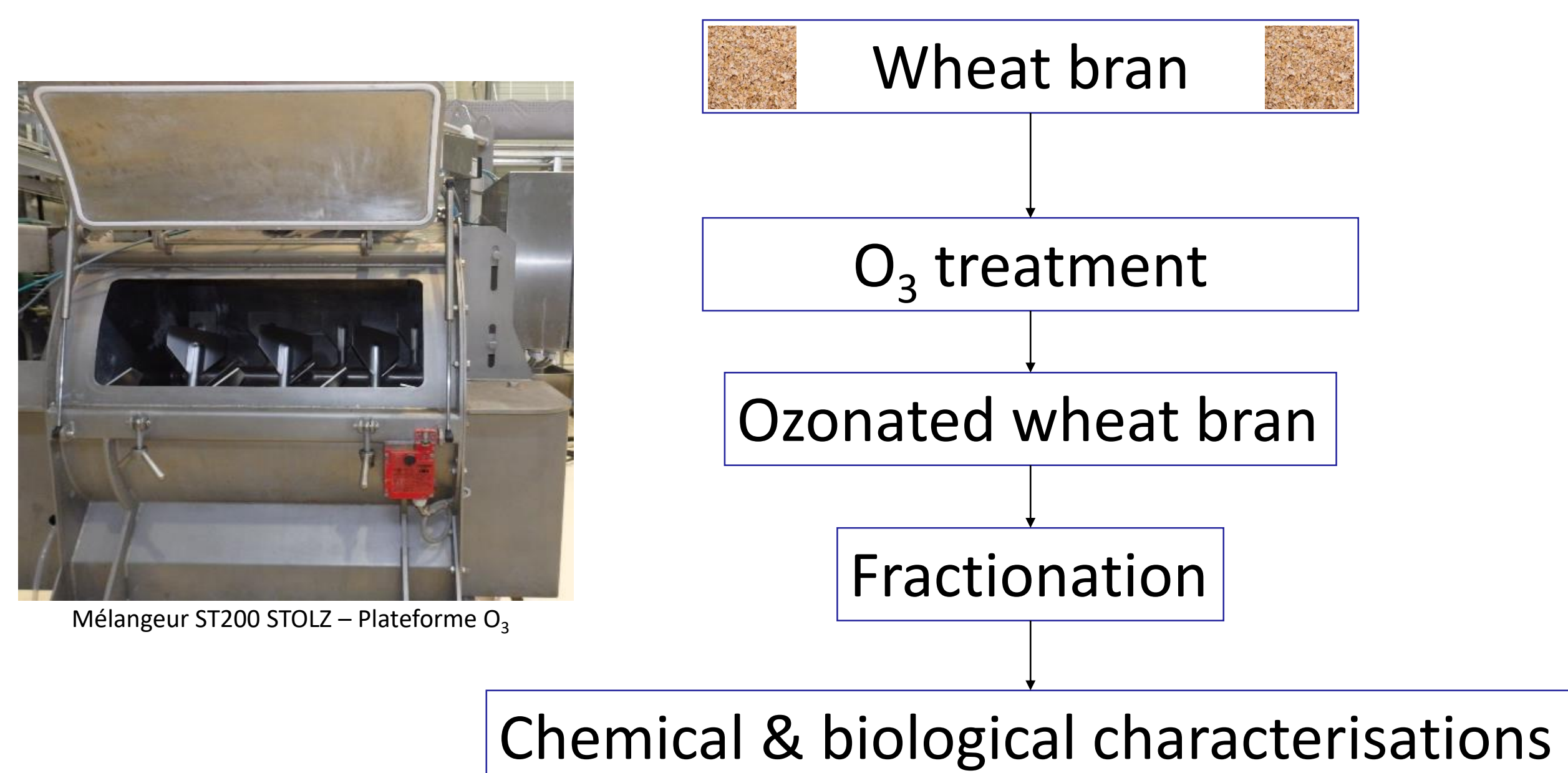
Dietary fibers (DF) are defined as carbohydrate polymers which are non-digestible in the upper intestine. DF provide many known health benefits including the reduction of coronary heart diseases and hypertension and the prevention of colon cancer, diabetes and obesity [1].

Arabinoxylans (AX) and β -glucans are non-starchy polysaccharides which represent the largest part of DF in wheat [2]. Polyphenols, known for their antioxidant capacity, interact with DF. Hence, DF can impact the polyphenol bioaccessibility during digestion and may limit their bioactivities [3].

The goal of this project is to improve nutritional and health benefits of wheat non-starch polysaccharides by ozone treatment.

Ozone (O_3) is a green process mostly known for water disinfection but already used in industry for wheat grain decontamination (Oxygreen process [4]). As well as limiting the contaminants, ozone is also used to bleach and to decrease the bitterness of wheat [5]. Preliminary results on wheat bran have shown that O_3 increased soluble dietary fiber (SDF) content [Unilasalle].

Materials and Methods



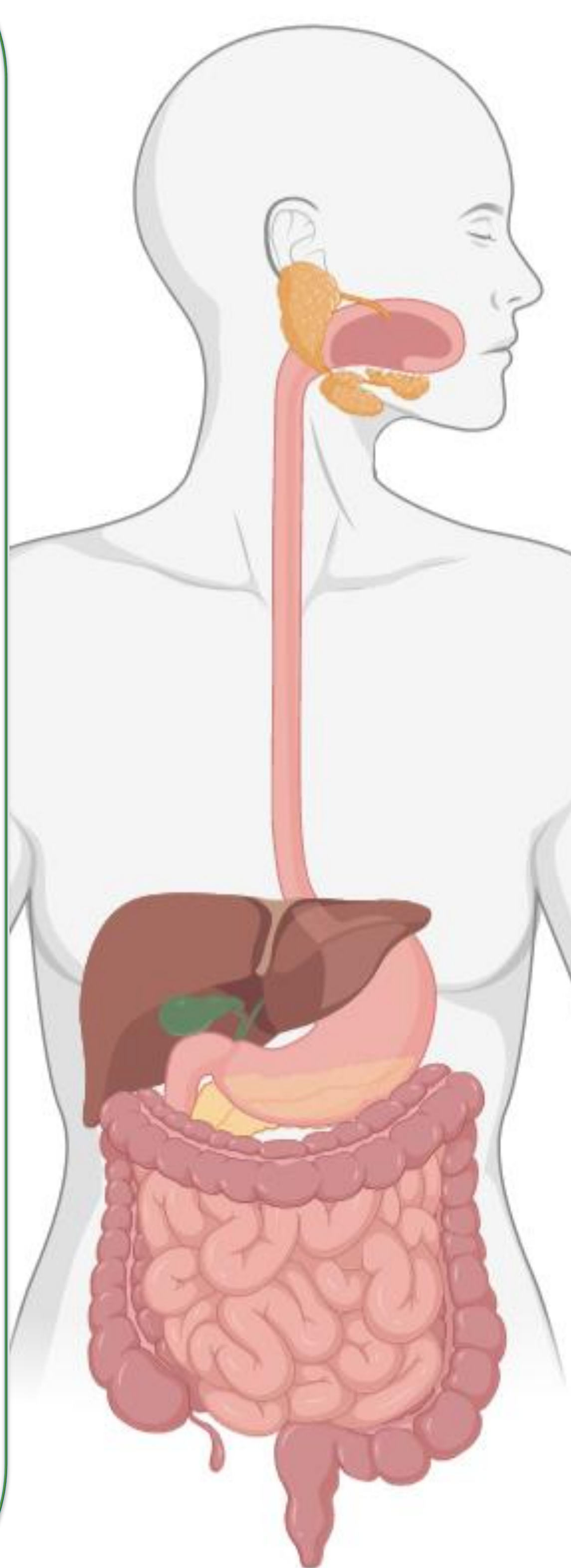
Parameters used to modify O_3 consumption.
 Aw = Variable
 $[O_3]$ = Variable
 Time = Stable
 O_3 flow rate = Stable
Ozonation Marker:
 pH

Expected Results

Improvement of the bioactive compounds' bioavailability – Changes in AX and β -glucans molecular distribution.

Impact of ozone treatment on fiber chemical composition

Parameters	Expectations
Soluble and Insoluble fiber content	<ul style="list-style-type: none"> SDF increase [6] \nearrow SCFA production, \searrow Postprandial glucose response, \nearrow Cholesterol absorption
Phenolic compounds and antioxidant (AO) characterization	<ul style="list-style-type: none"> \nearrow Bioavailabilities \nearrow AO capacity, \searrow Reactive Oxygen Species (ROS) production
Non-starch polysaccharids characterisation	<ul style="list-style-type: none"> Change in molecular distribution of AX: <ul style="list-style-type: none"> \nearrow Immunomodulatory & AO activity, \searrow Glucose response, \nearrow Satiety [7] β-glucan depolymerisation [6] \nearrow Prebiotic effect: <ul style="list-style-type: none"> \searrow carcinoma cells proliferation [8, 9]
Physical characterisation	<ul style="list-style-type: none"> \nearrow Viscosity Water holding capacity Particle size
Functional proprieties	<ul style="list-style-type: none"> \nearrow Cholesterol adsorption capacity [10] \nearrow Glucose adsorption capacity Enzyme activities

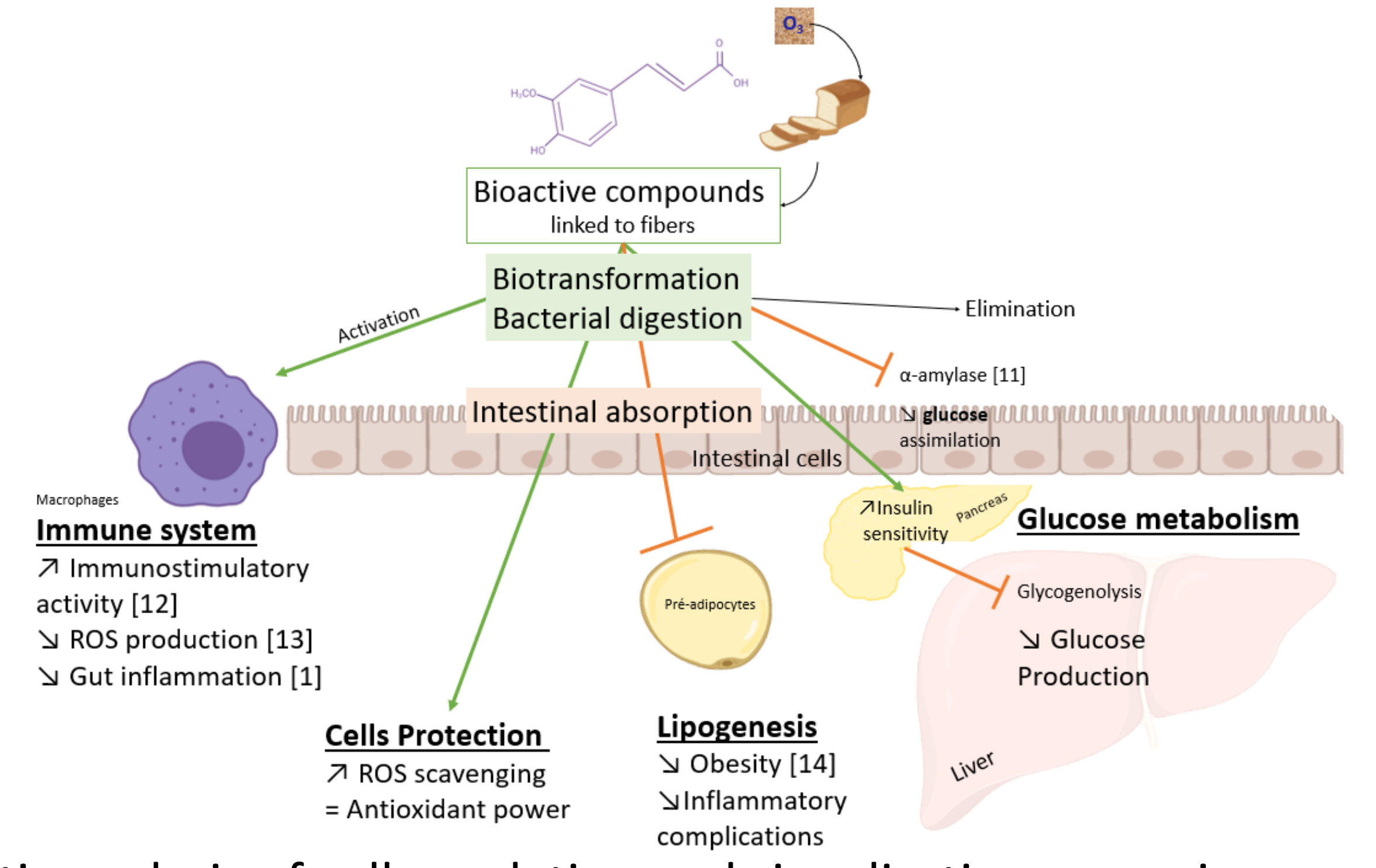


Characterisation of biological impacts

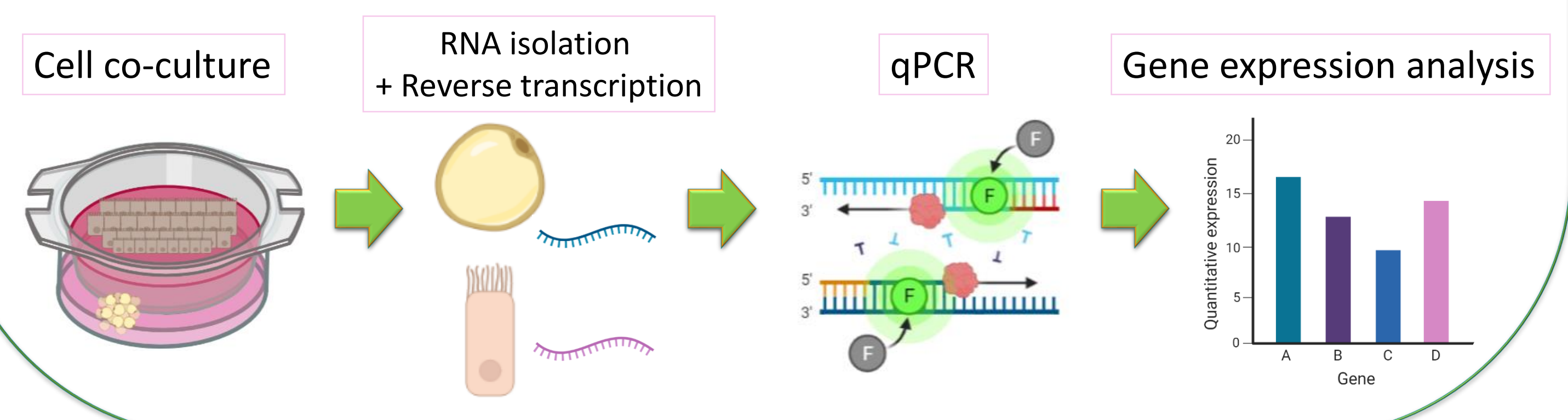
In vitro digestion characterisation (SHIME®)
Prebiotic effects: Fibers fermentation and microbial studies.
 \nearrow Short-Chain Fatty Acids (SCFA), \searrow Inflammation.

Cell culture models

❖ Impact of modified bioactive compounds on glucose absorption, lipogenesis, cell protection (AO capacity), and immune system.



❖ Genetic analysis of cell regulation and signalization mechanisms



References:
 [1] Anderson, J.W., Baird, P., Davis, R.H., Ferreri, S., Knudtson, M., Koraym, A., Waters, V., Williams, C.L. Health benefits of dietary fiber. *Nutrition Reviews*, Vol. 67, Issue 4, 188-205, 2009.
 [2] Izidorczyk M.S., Dexter J.E., Barley β -glucans and arabinoxylans: Molecular structure, physicochemical properties, and uses in food products—a Review. *Food Research International*, Vol. 41, 9, 850-868, 2008.
 [3] Jakobek, L., Matić, P. Non-covalent dietary fiber - Polyphenol interactions and their influence on polyphenol bioaccessibility. *Trends in Food Science & Technology*, Vol. 83, 235-247, 2019.
 [4] Interreg ALCOTRA, La terre dei Savoia, DISAFA, FranceAgriMer, CRIEPPAM. Technologie de décontamination : ozone gazeux. CTCPA, 11, 2017.
 [5] Monsalve-Gonzalez, A., Prakash, A. Bran and bran containing products of improved flavor and methods of preparation (US Patent No: US 8,053,010 B2) General Mills, Inc., 2011.
 [6] Gozè, P. Ozonation des grains de blé tendre: étude de l'oxydation des constituants biochimiques majeurs. Thèse de doctorat, Université de Technologie de Compiègne, 2016.
 [7] Li, J., Du, J. Molecular Characterization of Arabinoxylan from Wheat Beer, Beer Foam and Defoamed Beer. *Molecules*, Vol. 24, 7, 1230, 2019.
 [8] Broekaert, W.F., Courtin, C.M., Verbeke, K., Van de Wiele, T., Verstraete, W., Delcour, J.A. Prebiotic and Other Health-Related Effects of Cereal-Derived Arabinoxylans, Arabinoxylan-Oligosaccharides, and Xylooligosaccharides. *Critical Reviews in Food Science and Nutrition*, Vol. 51, 2, 178-194, 2011.
 [9] Paesani, C., Degano, A.L., Zalosnik, M.I., Fabi, J.P., Pérez, G.T. Enzymatic modification of arabinoxylans from soft and hard Argentinian wheat inhibits the viability of HCT-116 cells. *Food Research International*, Vol. 147, 110-466, 2021.
 [10] Chen, H., Xiong, M., Bai, T., Chen, D., Zhang, Q., Lin, D., Liu, Y., Liu, A., Huang, Z., Qin, W. Comparative study on the structure, physicochemical, and functional properties of dietary fiber extracts from quinoa and wheat. *LWT - Food Science and Technology*, Vol. 149, 111816, 2021.
 [11] Sharma, P., Hajam, Y.A., Kumar, R., Rai, S. Complementary and alternative medicine for the treatment of diabetes and associated complications: A review on therapeutic role of polyphenols. *Phytomedicine Plus*, Vol. 2, 1, 100-188, 2022.
 [12] Srinivasan, A., Ekambaram, S.P., Perumal, S.S., Aruldas, J., Erusappan, T. Chemical characterization and immunostimulatory activity of phenolic acid bound arabinoxylans derived from foxtail and barnyard millets. *Journal of Food Biochemistry*, Vol. 44, 2, 13116, 2020.
 [13] Rebollo-Hernanz, M., Zhang, Q., Aguilera, Y., Martín-Cabrejas, M.A., Gonzalez de Mejia, E. Phenolic compounds from coffee by-products modulate adipogenesis-related inflammation, mitochondrial dysfunction, and insulin resistance in adipocytes, via insulin/PI3K/AKT signaling pathways. *Food and Chemical Toxicology*, Vol. 132, 110-672, 2019.
 [14] Singh, M., Thirumavithana, T., Shukla, R., Adhikari, B. Managing obesity through natural polyphenols: A review. *Future Foods*, Vol. 1-2, 100002, 2020.

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