Gembloux Agro-Bio Tech
Université de Liège

Le Corps professoral de

Gembloux Agro-Bio Tech - Université de Liège vous prie

de lui faire l'honneur d'assister à la défense publique de la dissertation originale que

Monsieur ODJO Djossè Psijus Sylvanus,

Titulaire d'un diplôme d'ingénieur agronome,

Titulaire d'un master complémentaire en sciences et technologie des aliments,

présentera en vue de l'obtention du grade et du diplôme de

DOCTEUR EN SCIENCES AGRONOMIQUES ET INGENIERIE BIOLOGIQUE,

le 21 novembre 2016, à 13 heures 30 précises (personne ne sera admis après cette heure),

en l'auditorium CA (Chimie Analytique)**,**

2, Passage des Déportés à 5030 **GEMBLOUX.**

Cette dissertation originale a pour titre :

« Contribution to the study of the effect of drying on the nutritive value of corn grain (Zea mays L.) for poultry and pigs feeding »

Le jury est composé comme suit :

Présidente : Prof. M.-L. FAUCONNIER : Présidente du Département AgroBioChem,
Membres : Prof. F. BERA (Promoteur), Dr P. MALUMBA (Copromoteur), Prof. Y. BECKERS, Prof. J. BINDELLE, Prof. G. LOGNAY, Prof. Y. LARONDELLE (UCL), Dr G. SINNAEVE CRA-W), Prof. J. DOSSOU (Université d'Abomey-Calavi, Bénin).

Résumé

Corn grain (*Zea mays L.*) is widely produced all over the world and is intensively used in poultry and pigs feeding. Drying with hot air is usually utilized to preserve corn after harvest by decreasing the water content. During high temperature drying, major components (starch and proteins) of corn grain undergo some structural changes with possible nutritional implication. This thesis aimed at increasing knowledge regarding the effect of the drying process on the feeding value of the corn grain for broilers and pig feeding in order to improve its zootechnical performance.

In a first experiment, the effect of fluidized-bed drying on the *in vitro* digestibility of dry matter, starch and protein was assessed using a sequential pepsin-pancreatin protocol. It appears that when corn grains harvested at similar moisture content are dried at different temperatures, the digestibility of starch and that of crude proteins are not affected in a similar way. Higher drying temperatures increased the final digestibility of starch while the digestibility of crude proteins decreased mainly during the buffer and pepsin step of digestion. Higher drying temperatures also affected the kinetics of starch digestion. Differences in the observed trend were related to the structural modifications induced within starch granules and proteins in response to the drying conditions.

As the digestion of starch involves the breakdown of glycosidic bonds and results in the production of various oligosaccharides, an experiment was performed in order to assess a procedure that can be used after the *in vitro* digestion of corn granules to appreciate the nature of saccharides released. Three methods were thus compared in their ability to provide relevant information about sugar released during *in vitro* procedure of different corn samples. High Performance Anion Exchange Chromatography coupled with a Pulsed Amperometric Detector was revealed to give the most effective qualitative and quantitative information regarding the digestion of starch after a pepsin-pancreatin digestion scheme. Five major saccharides as the result of *in vitro* pepsin-pancreatin digestion of corn grain were found: glucose, isomaltose, maltose, maltotriose and glucosyl-maltotriose. This suggests that structural changes occurring within starch granules during drying (partial gelatinization) lead to different digestion profiles in the small intestine.

The second major component of the corn grain, namely protein is also affected by the drying process. The decrease in the crude protein digestibility with a high drying temperature was associated with protein denaturation. Among corn protein subgroups, salt-soluble proteins are the most sensitive to heat and their solubility decreases when the drying temperature increases. The denaturation of salt-soluble proteins during corn drying and hydrothermal treatment was monitored and modelled using the drying process parameters. Modeling of salt-soluble protein revealed that the evolution of extractible salt-soluble protein content from corn kernels during drying at high temperature is more correctly described with a second order kinetic reaction and depends mainly on temperature and moisture content. The relationship between the *in vitro* digestibility of dry matter and the salt-soluble protein index was assessed in order to use it as an indicator of corn digestion. It was found that the use of salt-soluble protein index as an indicator of the nutritive value of corn grain could lead to doubtful conclusion due to confounding factors (temperature and moisture content). Further research should focus on the relationship between *in vivo* parameters and the kinetics of starch digestion.