SLU
ALNARP

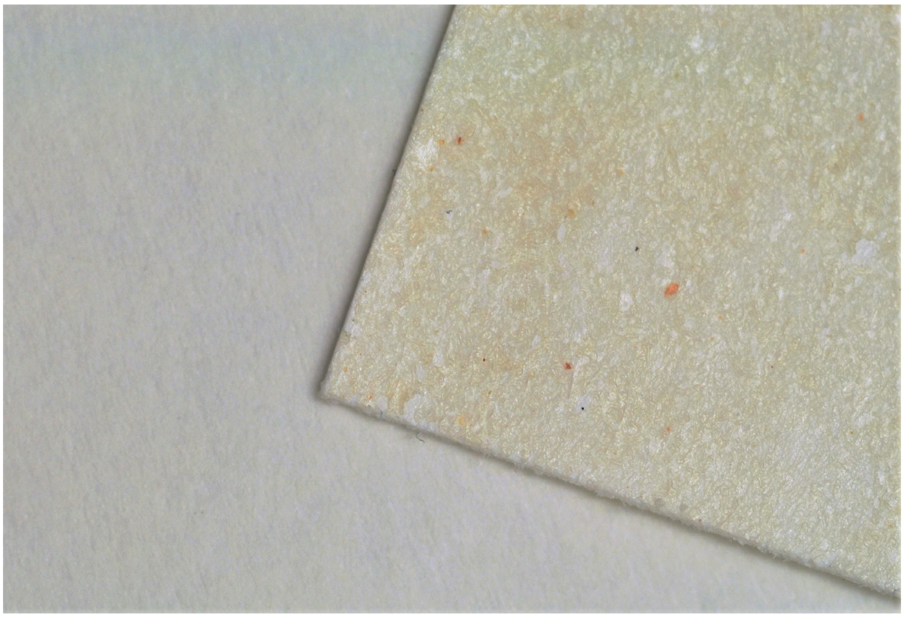
LTV-fakultetens faktablad
2016:19

Fakta från Partnerskap Alnarp

Sustainable packaging from an agricultural product side-stream

William R. Newson and Eva Johansson

Will agricultural side streams be the solution for production of future food packages? Our results indicate the usefulness of wheat gluten, a side stream from the ethanol and starch industry, as a raw material for packaging production. Wheat gluten coated paperboard showed excellent barrier properties while being produced with existing industrial processes. Our work will contribute to a sustainable circular bio-based economy through the exchange of petroleum based feed-stocks. This will increase the environmentally friendly use of plant based side streams as the raw material for food packaging solutions.



Wheat gluten coated paperboard has good oxygen barrier properties and grease resistance.

Why is it important to develop novel solutions for food packages?

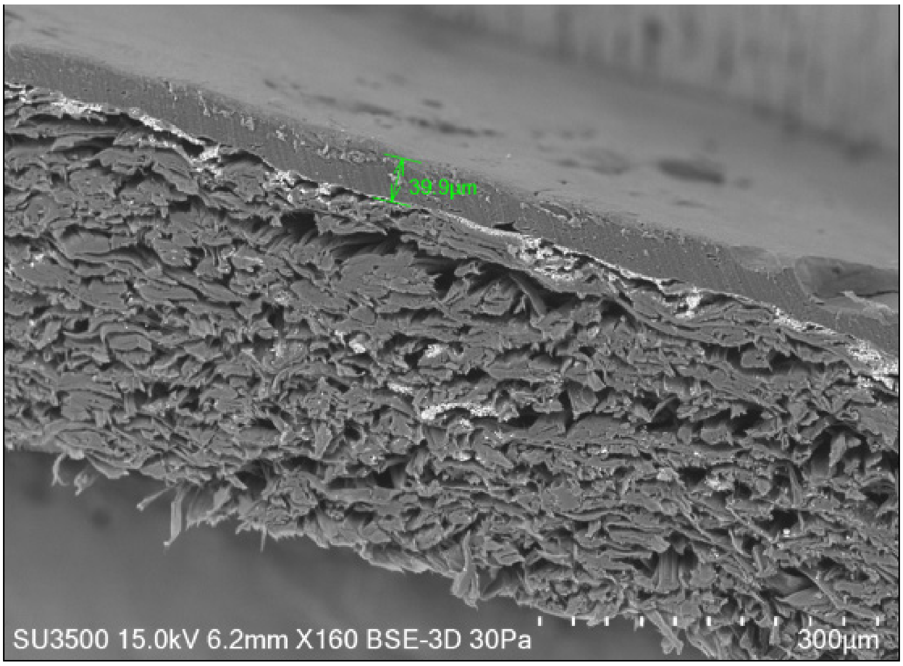
Food packages are important solutions for transporting and protecting the food so that it is easily and safely handled by retailers and consumers. The most common solution for such packages is paperboard based. Thus, paperboard products surround us in everyday life, although even these materials are not perfect. One problem is that paperboard readily allows gases to pass through it, making it unsuitable for many packaging applications. To combat this paperboards are often coated to improve the barrier properties and give them better aesthetics. Currently, most of these coatings depend on petroleum based plastics. For a more sustainable and circular use of natural resources, other solutions have to be searched for.

Opportunities with wheat gluten as an alternative solution for food packaging

Wheat gluten is a sustainable and excellent candidate for paperboard coatings. Wheat gluten is a good barrier to gases like oxygen that can cause product spoilage and it is also biodegradable, bio-based and environmentally attractive like the underlying paperboard. Besides that, wheat gluten is a readily available and relatively cheap material, originating as a side stream within the starch and ethanol production industry.

Wheat is cultivated in Sweden for human and animal food and as an industrial feedstock. As an industrial feedstock, wheat is separated into wheat starch and protein rich wheat gluten. There are many industrial uses for wheat starch, for example bioethanol production for E85 fuel. The wheat gluten is added to wheat flour to improve its properties or used as animal feed among other products. With an increasing demand for starch to be used in feeding microbes like yeast for the industrial production of alcohol and green chemicals, new high value products are being sought for wheat gluten as the secondary product of wheat starch production.

Wheat gluten is the part of wheat flour that makes bread dough elastic so it can hold onto the bubbles that create a good loaf of bread. This elastic property also makes wheat gluten a candidate for forming new materials that could replace some unsustainable pet-



Cross section of wheat gluten coating on paperboard. Coating thickness 0.04 mm, thinner than a human hair. Photo: Henrik Pettersson.

roleum based plastics and coatings. The same properties that make wheat gluten good for bread make the protein difficult to make into products - it sticks together too easily making it hard to form using our current tools. Controlling this wheat gluten "hardening" will make it easier to form products from this sustainable side stream.

Problems to solve if wheat gluten should be used for coated paperboards

To make gluten based coatings as environmentally and economically attractive as possible, paperboard production with gluten coatings needs to be energy efficient and production needs to be on a large scale. Proteins like wheat gluten have been applied to paperboard dispersed in water, but the energy required for drying the film takes a significant amount of energy and slows the process. Various means of coating wheat gluten in an energy efficient way have been investigated.

For a successful coated paperboard we need a layer of wheat gluten that is free from holes. In order to successfully produce a wheat gluten protein film and have a flexible final product, we need to add plasticizers to soften the protein (e.g. glycerol, E422) or to modify the protein structure (e.g. urea, E927b). Even with a plasticizer the wheat gluten can still harden during processing. Using food grade reducing agents (e.g. sulphites, E221) we can slow down this hardening during processing. By varying parameters such as temperature, level of reducing agents, structure modifying agents and plasticizers we are able to coat wheat gluten onto paperboard.

Performance of wheat gluten coated paperboards

The wheat gluten coated paperboard produced in this project had excellent oxygen barrier properties compared to previously reported attempts. As oxygen is a major contributor to the spoiling of food this could lead to longer shelf life for packaged goods. Not only is the wheat gluten coated paperboard resistant to oxygen, but tests indicate that it is resistant to oil making it suitable for a wide range of packaging, such as higher fat content baked goods like croissants and muffins.

These wheat gluten coated paperboards not only provide a market for wheat gluten, but provide a biobased and biodegradeable alternative to paperboard coated with petrochemical based coatings. In order to bring our findings into commercially produced food packages consisting of wheat gluten coated paperboards, we have from Nov 2016 transferred this project into a Vinnova funded UDI stage 1 project. In this collaboration between SLU Alnarp, KTH, Karlstad University, Innventia AB and Lantmännen AB we are looking forward to a product that protects your food in the future.

Participating researchers:
William Newson and Eva Johansson, Swedish University of Agricultural sciences; Mikael Gällstedt, Henrik Pettersson, Kristina Junel and Therese Johansson, Innventia AB; Mikael S. Hedenqvist, KTH Royal Institute of Technology; Henrik Ullsten, Karlstad University. Mikael Gällstedt is now at SIG Combibloc AB.

Faktabladet är utarbetat inom LTV-Fakultetens Instutionen av Växtforädling, www.slu.se/institutioner/vaxtforadling/

Projektet är samfinansierat av Lantmännen, Trees and Crops for the Future (TC4F), Lantmännens Forskningsstiftelse och Partnerskap Alnarp

Projektansvarig William Newson, som också är huvudförfattare till detta faktablad, bill.newson@slu.se, www.slu.se/institutioner/vaxtforadling/personal/