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Editorial

An Insight of Nanocellulose in Food and Agriculture Industries

Khalisanni Khalid*

Agri-Nanotechnology Program, Biotechnology and Nanotechnology Research Centre, Malaysian Agricultural Research and Development Institute (MARDI), MARDI Headquarters, Persiaran MARDI-UPM, Serdang, Selangor, Malaysia

***Corresponding Author**: Khalisanni Khalid, Agri-Nanotechnology Program, Biotechnology and Nanotechnology Research Centre, Malaysian Agricultural Research and Development Institute (MARDI), MARDI Headquarters, Persiaran MARDI-UPM, Serdang, Selangor, Malaysia.

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Agro-biomass is composed mainly of cellulose, hemicellulose and lignin. Cellulose is the most abundant and renewable biopolymer in nature. It is the main constituent of plant cell walls in wood, cotton, hemp and other plant-based materials and plays an essential role in maintain plant structure. As an abundance materials in the world, many research have been done to value add the cellulose materials such as acid hydrolysis treatment to yield microcrystalline cellulose for its various applications. However, the low aspect ratio and intervening amorphous region of microcrystalline cellulose make it unfit for use as fillers in composites. Hence, the preparation of nano-cellulose and their use as fillers in various composites will be a value addition to non-spinnable cotton, cotton linters and other cellulosic biomass.

Plastic materials are commonly used in agricultural practices for a variety of applications that include mulch films, greenhouse construction materials, packaging materials, etc. Conventionally, such plastics are manufactured from petroleum derivatives that are not degradable and persist in the environment long after their useful life is over. As a result, interest in the use of naturally degradable and/or biodegradable polymers for plastic manufacturing, particularly for use in agriculture, has grown considerably in recent years. Efforts have been made to develop environmentally compatible plastic products by incorporating renewable polymers as an alternative to petroleum-derived chemicals.

The renewable polymers are relatively inexpensive, environmentally friendly, and also naturally biodegradable. Particularly, plant material derived from renewable crops, by-products or their industrially processed wastes, offer a good source of fiber for applications. Global production capacity for biodegradable polymers has grown dramatically since the mid-1990s. In recent years, global production capacity for biodegradable polymers has increases more than 400,000 tonnes compared with 20,000 tonnes in 1995. Renewable resource based biopolymers such as starch and other biodegradable polymers account for around 85% of the total production capacity with synthetic biopolymers accounting for the remaining 15%. The most widely used agricultural plastics are mulch films which cover more than 4 million hectares worldwide. Despite the availability of biodegradable polymers, the lack of structural and functional stability prevents their commercial use. There is a strong potential for low-cost starch and cellulose based polymers for commodity applications, particularly since the monomer can be obtained from renewable agricultural resources. But, high water vapour permeability and poor mechanical strength prevents their large scale exploitation. The use of nanocellulose as filler could improve the performance of these biodegradable films due to its high crystallinity and better interfacial interaction. Because of its high biocompatibility, bio-degradability, low-cost and easy availability, nanocellulose finds application in disparate areas of research. The fairly new idea of bio-nanocomposites is an initiative to develop next generation novel eco-friendly packaging materials with superior performance that could find extensive applications in food packaging and agricultural field mulching.

In the agriculture sector, previous study suggested the application of PVA/nanocellulose as mulch films. These materials are also applied to the agricultural practice of mulching. The effectiveness of materials was assessed based on the growth and yield of lettuce and

corn. Encouraging results on the plant growth and crop yields were obtained. The material also demonstrated positive effects on the maintenance of soil structure. The mulches based on PVA and agro-wastes showed achievement of similar enhancement in crop production compared to PE mulches. Such composites have higher cost effectiveness than plastic mulches while at the same time are able to reduce the environmental concern.

Bioactive packaging is gaining more and more interest not only due to its environment friendly nature but also due to its potential to improve food quality and safety during packaging. Market opportunities in food packaging include the use of cellulose nanomaterial coatings and materials as barriers and/or as sensors. This opportunity benefits from the ability of cellulose nanomaterial packaging to provide a vapour barrier that improves freshness and reduces odour. Some of the short comings of biopolymers, such as weak mechanical and barrier properties can be significantly enhanced by the use of nanocellulose such as cellulose nanocrystals (CNCs). The use of CNCs can also extend the food shelf life and improve the food quality as they can serve as carriers of some active substances, such as antioxidants and antimicrobials. The CNCs fiber based composites have great potential in the preparation of cheap, lightweight, and very strong nanocomposites for food packaging. In particular, CNC based polymeric packaging films have made remarkable progress as materials for improving food preservation, mechanical and water vapor barrier properties and confirmed the possibility of CNCs being reinforcing fillers for products such as food packaging films.

From the abovementioned point of view, nanocellulose are already promising new materials that have attracted attention from many food and agricultural fields. Nanocellulose extracted from agricultural by products is relatively simple to produce with low energy costs. Although yields are low, producing nanocellulose from underutilized agricultural by products has commercial applicability and can generate additional income for farmers hence contributes to the food and agricultural national self-sufficiency level (SSL) of the nation.

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