



ILSI 2021 Annual Symposium Session 3: Innovative Packaging

Transcript of the presentation, Compostable Packaging: Technical Possibilities, Consumer Attitudes and Behaviours in the UK and China, [Caroline Orfila](#), PhD, School of Food Science and Nutrition, University of Leeds, United Kingdom, on behalf of the Citrusafe consortium

So, yes, I come from the University of Leeds, and I am co-leading a project called Citrusafe, which focuses on the valorization of byproducts from the Chinese Citrus Processing Industry. And today I'm going to tell you a little bit about this project and some of the innovations in packaging that were realized. But also, we'll focus most of my talk on a survey that we did on the consumer attitudes and behaviors towards recyclable and compostable packaging in the UK and in China.

So, the Citrusafe project was an academic-industrial partnership project involving academics from both the UK and China and industries from the UK and China. So, from the Academic's perspective, there was University of Leeds, Zhejiang University and Zhejiang GongShang University. And we were funded by the BBSRC, the Newton Fund and the ministry of science and technology of the People's Republic of China.

The academic side, sorry, the industrial companies, including Parkside flexibles, Keracol, IO Power, and two industries in China called Joyful and Huayu. And the industry partners were funded partially by innovate UK, which is the innovation agency for the United Kingdom.

The global issues that we were trying to address through Citrusafe was to reduce food loss and waste. As we know that a third of food that is produced is lost or wasted before it's eaten. And packaging has a really good role in preventing some of these foods to be lost. And just reminding you that wasted food represents a waste of resources in terms of the land it's needed to grow it, the energy, the water, the labor that goes into it, but also that it's disposal food waste also poses a burden to land aquatic environments. The Citrusafe we will also addressing food safety, again, a place where packaging has a big role to play. And we do know that around one in 10 people in the world will fall ill after eating contaminated food with the loss of many millions, loss of a healthy life.

Yes. And finally, we were looking at dietary health. We know that obesity and overweight are rising worldwide, and a lot of these obesity can be attributed to poor diets. And these poor diets are characterized by low fiber intakes, where in general, across UK and China, we see 30% lower intake of fiber than recommended and high intakes of saturated fat. So, I will take you a little bit through what we did in that aspect as well. So, the project was organized in terms of valorizing these ways from the Citrus Industry and looking at food safety in terms of formulation using byproducts from the Citrus Processing Industry as natural additives and preservatives, but also big component was packaging either using the materials directly to make packaging or as active materials or coatings on already existing packaging. And we have already heard some talk, some of that aspect, how it's done in... In the previous talks.

And then through the health aspect, we had a brunch that looked at utilization of these byproducts in skincare, which I'm not going to talk about today and also application for functional foods and supplements. So, it was quite a large program of work, but I will tell you a bit more about the packaging later. Why the Citrus Processing Industry? Well, actually China is now the biggest producers...producer of Citrus fruits in the world, the annual production last year of around 39 million tons of Citrus fruits. And about half of those are Mandarins Citrus unshiu. The processing industry generates about 1 million tons of solid waste streams, primarily as peels, but also pips and other solid residues and 2 million tons of liquid waste streams.

How are these waste streams produced? Yeah, let's talk about this later. So, we started obviously with the Mandarin fruit, which is then peeled manually actually to have the segments. And we have, then the peel waste, which we can use as a resource. The segments are then separated again manually. And these are soaked in an acid bath where we get some of the membrane around the Mandarin removed and the production of this acid extraction liquid, which is this liquid. You can see here, flowing through these pipes. The segments are then soaked in an alkaline bath, which will remove the remaining of the membrane. And you will generate an outline extraction liquid. These segments are then canned, or they can be put into bottles like this one, okay. And then exported and enjoyed throughout the world with a very good and long shelf life. The extraction liquids can be combined and that neutralizes the liquid, and the liquid waste is then treated with ethanol to precipitate some biopolymers.

And then you end up with some ingredients which are reusable in several applications. I should say that this liquid waste has high chemical oxygen demand. So, currently China has some legislation that says that this liquid waste, because of its high chemical oxygen demand cannot be disposed in natural water or in natural land, it has to be treated somehow. And therefore, this way of recovering the biopolymers is a way to reduce the chemical oxygen demand and actually valorizing some of that so-called waste at the same time. And the quota had in the previous slide, was one from a colleague who works in environmental management, who told me, waste is not waste is just resourcing the wrong place. And we really took this to heart to say, actually, these are not waste streams. They are resource streams that we can then valorize and utilize.

So, the thing... The aspect I'm going to talk to you mostly today's is the peel aspect where the peels can be shredded and dried initially because they are very wet. So, they decompose very quickly. And then mi... We applied micronization to make powders of different particles sizes that can be then extracted using green methods. So many water-based methods dried, and we obtained various extracts, which are then used. So, we had food grade powders and liquid ingredients that were either used to produce cosmetics. And there was... There is a line of cosmetics currently being commercialized in the United Kingdom. We also have various edible formats including gels, emulsions and films. The gels and emulsions were primarily used as ingredients for fat replacement. And then we had a packaging stream where the ingredients were mainly incorporated as coatings on the surface of compostable packaging. And compostable packaging that comes in many different substrates, so you can get different properties of the material as we've heard earlier, but this can be functionalized then with different properties.

So, the packaging aspect was done by a company called Parkside flexibles, which is quite near here in Wakefield, near Leeds. And they develop different packaging solutions. And they are... They're much at the forefront of developing compostable packaging material and there is an accreditation in the United Kingdom around how long should it take for a packaging to decompose or compost in a home. So, here you have an example of a snack that is packaged in compostable material, and you can see that over six

weeks, it will then break up. You can see it breaking up here, eventually to little pieces and starting to disappear into the compost. Okay, and then you can see actually some of the asparagus actually is still there after six weeks. So, it seems to be fairly well degraded over time. And we know that this approach can be helpful in reducing plastic particles in soils, which as we heard earlier are a great environmental concern.

And a study in Italy showed that composting packaging material can reduce particles in soils from 20% occurrence to 1.5. So, it can be quite effective. So as part of the Citrusafe project, we explore different packaging morphologies. If you like, we were looking primarily at things that have short shelf lives, including bread, which is one of the most wasted category of food in the United Kingdom. We also looked at some high-risk products, including fish and chicken. We looked at ripening or fruits, and we also started looking at ready meals and ready meals are interested... Actually, all of these are interesting because often they have more than one packaging component. And so, you have to look at not just one, but several packaging components, often a see-through one to allow the consumer to see the product. And then you have something else that you can print on. So, in the case of ready-made meals, they often have a cardboard sleeve with all the information on it. And then you have a tray that is holding the product.

But we do know that you know, packaging has a strong contribution to reducing food loss and waste. And in the UK, manufacturers are looking at you know, even one day shelf-life extension could save the UK 2.2 billion pounds per year. So, it does make not just economic and not just environmental sense, but also economic sense.

And I'm not going to talk too much about the technical aspects of these packaging, but I'm going to tell you some preliminary results about some of a survey that we did in both China and the UK, and the numbers of participants are quite small, but I think it started giving us some really interesting insights about what consumers think about environmentally friendly packaging. And in particular I'll highlight the attitudes towards compostable packaging or the knowledge of that. So, the question that we structured in looking at the motivations for purchasing, will people buy it or not? Will they pay more for it? The recycling and composting behavior? So, what, what do people do with the packaging once it's in their home? And also rating their environmental consciences and knowledge. And I won't have time to take you through all of them... All of the aspects today, but I will give you some highlights.

So, one of the things that we asked them, first of all, is: are you actually trying to reduce the amount of food packaging that you buy or use? And certainly, that's something that we observe in the United Kingdom where there is a big ambition by consumers to reduce, eliminate food packaging, not necessarily understanding the impacts that that might have on increasing food loss and waste, and perhaps in increasing food safety risks. But we can see that 78% of UK consumers actually want to reduce the amount of packaging that they use, but they said that it's difficult for them for limited opt... Because they have limited options available. So perhaps the best thing for them after trying to reduce food packaging is to look at environmentally friendly packaging. In China, it's actually a more mixed picture. And in China, there's actually a lot less food packaging than there is in Europe and in the U.S very few foods are actually packaged at the moment, but it's really rising very, very quickly.

So, the people that are trying to reduce food packaging are 45- to 75-year-olds with bachelor's degree or above and certain generally higher environmental consciousness, but we didn't see an effect of gender or total income. [inaudible 00:13:55] motivations we then ask them about, would you buy environmentally friendly packaging? And we looked at if you buy it, what are your motivations for

buying this packaging? And we can see here that the main motivation is to reduce environmental waste with the top answer in the UK and second answer in China. In China, when we saw that reducing human toxicity was the top option, and I think there was a perception that packaging that can actually, they are concerned about the toxicity of the packaging itself, having some transfer of some packaging materials or chemicals from the packaging into the food.

Well, that was a lot lowered down in the United Kingdom. In terms of purchasing berries, so why would... Why are you not buying environmentally friendly packaging? It came again, it came back to there are very few options available for me to choose from. And that was the top reason in both the UK and China. And in China, the second reason was again, were being worried about food safety. So, being worried that perhaps the environmentally friendly packaging doesn't have the same performance as other packaging. Well, that was not a concern really much in the UK.

We also asked them if they would pay more for environmentally friendly packaging, and the answer was mostly yes, around 50% of people will pay around 10 Penn small, [inaudible 00:15:26] the equivalent in UN and 25% of people would pay 50 P more or the equivalent in yen...UN. But we did observe that all the consumers are less willing to pay more. So, we looked at recycling behaviors and we compared the two countries and in the United Kingdom, most people always recycled or did it most of the time, but it was actually a lot less common in China. And when we asked him about recycling bins and facilities for collection at home or from home rather, then that was a big enabler of recycling in the United Kingdom, while it was pretty limited in the... In China. So, a lot of people didn't have recycling bins at home and therefore did not recycle.

The motivations for recycling were to reduce the amounts of waste sent to landfills. And, you know, the other options underneath were mainly environmentally driven. In China, it was actually to reduce water pollution while in UK was mainly land pollution. But, for those people who recycled it was... They were less motivated by the government mandating that in their area. There's recycling barriers. The top one in the UK is that they're not always sure what materials are recyclable. And this is a real challenge for food packaging, where you have multiple components, some of which are recyclable, some of which are not. And people actually don't know and sometimes just throw the whole thing into the bin.

And that was the second option in China. There was also some mentioned in China, particularly about too much time and effort to wash the packaging. And that is something that we do know that before you recycle, you're meant to wash and get rid of some of the organic material to then to facilitate the recycling and it can be a barrier if it takes too much time and effort. So, we also explored very briefly some of the symbols that we can find on food packaging, and we asked them whether they were familiar with these, and most people were familiar with the recyclable symbol, but not so much with the biodegradable or compostable symbols. And when we did a survey of the different symbols that we could find on food packaging, particularly for ready-made meals, we found that for some supermarkets, particularly the ones that have their own branding, it tends to be quite consistent, and they tend to use this circular symbol here.

What, for some supermarkets that have more premium brands, and they have many, many different brands if you like. The... There was a great variety of different symbols and information, and so perhaps the consumers probably less sure about what to do with that packaging, where the information is different on different packaging and different products. And then when we asked the participants which type of information or how would you like to receive the information, they did prefer the kind of quite

simple, but consistent messaging above written instructions, or perhaps more different and more different information about the materials themselves. So that was quite insightful too.

And I think for me the most surprising not, but the thing that I think we need to work more on is the, what do people do with compostable food packaging when they have it at home? So, we do know that people want to buy more of these, but do they do what they're meant to do when they have it at home? And so when we asked them, well, how do you deal with your compostable packaging? The majority of people in the UK and in China put it in the normal waste bin. And then the second segment here in China is put it in the recycling bin, which is also a significant proportion of UK consumers and only, probably about a third compost it at home or send it to a compostable facility. And that was very small proportion, only 5% in China.

So, most consumers do not compost compostable food packaging at home, is that through lack of composting facilities, but also, we identified a lack of knowledge of what is compostable versus recyclable. And I think this has already been mentioned before but, if a compostable packaging ends up in the normal bin in a landfill, what happens to it? Compostable packaging will behave like paper or cardboard and biodegrade in the top layers where there's oxygen. But essentially, it's a linear process. So, it does end up as being waste. It will take a long time to recover that resource into anything useful.

In terms of recycling, again it has been alluded to earlier in earlier talks that putting compostable packaging in the recycling can cause problems. And this is particularly true for food packaging, with multi components, multi-layered parts where people might not separate everything, it becomes quite a big effort to work out what is what, what goes where and the car... Some of it, the compostable one can probably be incorporated into the cardboard recycling, but it does cause some issues. So, it's not ideal really, for perhaps consumers wanting to buy this compostable packaging, but not doing the right thing with it.

So, I think that take home messages are that people are motivated to buy environmentally friendly packaging and that is recyclable or compostable, and we'll pay a little bit more for it. But they are confused about how to dispose of it, particularly for compostable packaging. And there are limited home and communal composting facilities currently in the United Kingdom or in China, which is probably making... It's really limiting the ability to compost. So, that is coming to the end of my talk. So just to really thank the Citrusafe Consortium. So, these are over here, the UK participants of the consortium, but also, we were with a number of... With many great Chinese collaborators as well. Our funders who provided with the opportunity to do this project. And I want to thank you for your attention, and I will take some questions. Thank you.