Food Condiment Sachets from Bioplastics.
Open Ideo Submission.

Andrew Bisagaya, Charl Souma, Kinsley Ndeng'e, Mina Amin Youssief and Sarah Atmore
How might we get products to people without generating plastic waste?

Opportunity Areas

- Reimagine the Package - Design for zero waste

**TITLE: Food condiment sachets made of bioplastics.**

**Point of View statement.**

*Xavier, a young scholar who cares about the environment needs a hygienic way to get his food condiments in a world where single use small format packaging is not recycled.*

**DESCRIBE YOUR CONTRIBUTION IN ONE SENTENCE:**

Redesigning the composition and constituent materials of condiment sachets to make them quickly biodegradable when they end up at landfill sites.

*Figure 1: Proposed condiment sachets made of paper and bioplastics.*
FULL DESCRIPTION:
Our solution uses water hyacinth (*Eichhornia crassipes*) which is an invasive alien plant species to produce biodegradable plastic packaging material for the food condiments used in fast food outlets.

This can be used with a rating system to determine which businesses are environmentally friendly using biodegradable packaging as opposed to non-recycled plastic.
Chemical Process for the Manufacture of Bio-Plastics from Water Hyacinth.

The production of PHA from water hyacinth using Pseudomonas aeruginosa can be done following K Preethi, Vineetha, Mridul Umesh (2015) process:

1. Preparation of hydrolysates for fermentation

Water hyacinth is thoroughly washed with water to remove dirt. It is then dried in hot air oven at 70 °C for 48hrs and thereafter crushed into fine powder. About 8gram of Hyacinth dried powder is steam exploded in an autoclave at 121°C for 20min. To the wet pretreated material, sterile water is added (200ml) and boiled at 80°C for 30 min and filtered with cheesecloth to recover the hydrolysate.

This hydrolysate is then exposed to acidic hydrolysis with 1% HCl v/v and autoclaving at 121°C for 30 mins to break oligosaccharides into monosaccharides. The PH of the hydrolysate is then adjusted to 6-6.8 by adding NaOH then the precipitate is recovered by filtration with Whitman filter paper.

2. Fermentation:

Nutrient broth media (composed of; Glucose (10gm), Peptone (5gm), Yeast Extract (3gm), NaCl (5gm) in water hyacinth hydrolysate (1L)), with PH= 7, is inoculated with 10 % of culture of Pseudomonas, then incubated at 37 °C for 96hrs.

3. Extraction of PHA

The fermented media is centrifuged at 10,000rpm for 15min and the pellet is recovered and air dried. The cell pellet is then suspended in sodium hypochlorite solution and incubated at 37 °C for 1-2h for complete digestion of cell components except PHA. The mixture is centrifuged to recover PHA granules. The PHA granules are washed with distilled water then with 1:1 acetone and diethyl ether. Finally, to get PHA powder, the granules are dissolved in boiling chloroform then air dried.
Biodegradation:
Bacterially produced PHAs are fully biodegradable in both aerobic, anaerobic and marine environments, they, also, are biodegraded by many microorganisms and don’t require special environmental conditions (Muhammad, Shabina, Muhammad Afzal & Shafqat Hameed, 2015). PHA’s biodegradability in natural environments e.g. compost, sludge, soil, sea water, and rivers is its edge over petroleum-based plastics.

Limitations of PHA:

- High production costs
- Low yields,

However, to reduce the cost of production a polymer blend of PHAs with renewable materials, such as starch or cellulose, can be manufactured. A technique that requires a smaller amount of PHA per unit, yielding blends that are less expensive compared pure PHAs. Blends also degrade better than pure PHAs.

HOW DOES THIS IDEA REDESIGN UNRECYCLED SMALL FORMAT PLASTIC ITEMS THAT OFTEN END UP AS WASTE?

Currently, the small format packaging that we are targeting are in several cases made from foil and plastic coating for durability, better storing and to improve the lifespan of food products such as sauces.

As a solution to their non-recycled nature, we propose a different biodegradable material to make the sachets. Biodegradable plastics are developed from water hyacinth. The sachets are then made of paper covered in bioplastics. Not only will this meet the functional needs of the current sachet but also be an environmentally friendly option.

A third phase of our solution is developing a “non-degradable” rating system which can be used as marketing materials for fast food outlets that show a commitment to reducing non-recycled
packaging materials by using biodegradable plastics for packaging as opposed to the current non-recycled and non-biodegradable sachets.

**WHICH USE CASES AND GEOGRAPHICAL CONTEXT DOES YOUR IDEA APPLY TO?**

Our solution applies to user case one.

Our team is based in Cape Town. At present water hyacinth is a major threat to local biodiversity and freshwater ecosystems. Non-recycled waste is also a challenge in Cape Town. Both water hyacinth and non-recycled waste are collected and end up in landfills and in instances when they do not, they end up in the ocean. Our solution aims to use the water hyacinth to solve the problem of non-biodegradable, non-recycled sachets.

**HOW DO YOU ENVISION SCALING UP YOUR IDEA?**

The proposed sachets are part of an envisioned biodegradable plastics economy that gives back to the ecosystem.

Our idea is contextually relevant because the raw material is an invasive alien plant in Cape town. This makes it readily available and research shows, water hyacinth doubles in volume 2-3 weeks (Adegunloye D.V., Olosunde S.Y. and Omokanju A.B, 2013). We plan to collect it from the water ways and use it. At present the City collects it intermittently and takes it to landfills.

Fortunately for us, we are seeking a solution to the plastics problem at a time when the City of Cape Town is trying to discourage and eventually completely block businesses from disposing non-recycled waste at landfills. Our solution fits perfectly with the City’s intentions. Due to this, we will be able to leverage biodegradable plastics as a solution not only for the good of the environment but also as an answer to the problem businesses face because of the City regulations.
Therefore, a mass sensitization campaign targeting the involved businesses to make them aware of the added benefits of bioplastics should yield positive results and an uptake of our solution.

Although we acknowledge that the production of bioplastics costs more than petroleum based plastics, these added costs could be reduced by using PHA polymer blend and only as a coating for paper (hence using less of it per sachet). These proposed sachets will also result in a cost saving when it comes to waste disposal and transportation as they are compostable and do not need to be separated into a whole other category. The incentives given by the City to ‘green’ businesses could also be used to justify the added cost and as previously mentioned, the ratings system could also be marketing tool.

AT WHAT STAGE OF DEVELOPMENT IS YOUR IDEA?

Research and Early testing: We are exploring an idea, gathering inspiration and information needed to test it with real users. We also conducted some interviews with potential users to test the idea.

PLEASE DESCRIBE HOW BECOMING A TOP IDEA AND GETTING THE OPPORTUNITY TO WORK WITH THE NEW PLASTIC ECONOMY ACCELERATOR PROGRAM WILL HELP ACCELERATE YOUR SOLUTION.

We envision our solution as part of a whole ecosystem and it goes beyond the sachets. As a further step in our solution, we propose a ‘Grow-Away’ bag. The concept of a ‘Grow-Away’ bag is inspired by Nature's ecosystems. Everything which nature discards is reused/recycled in another smaller ecosystem, until the discarded item returns full circle, by giving back the energy which was used to create it.

The eco-system of waste products which we generate are primarily sent to landfills or recycling plants, but they do not give back to the ecosystem without consuming further energy to be of use, however if we use natures design, then less human intervention is required to dispose of the
waste products. This can be applied to single use waste products generated by fast food take away packaging.

Nature has perfected the model of a fruiting tree. It is this model that the grow away bag seeks to mimic. For example; when an apple falls off a tree, the apple doesn’t need to be thrown into a trash bin. Nature’s natural process will degrade it and return it into the ecosystem. The same design principles are envisioned for the future ecosystem of fast food take-away packaging and disposable products.

The Grow-Away bag is a circular ecosystem designed to be buried in your garden. All of the packaging and storage sachets, serviettes utensils are made from biodegradable plastics and paper or molded wood chips. The inside of the paper bag is lined with the seeds of indigenous plants from the plant biomes of the geographical location in which the takeaway product is sold in. These plants are specifically chosen due to certain characteristics which they can contribute back to the soil, thereby closing the circle. Depending on the current season certain seeded ‘Grow-Away’ bags will be available, to take into account what plants are best sown at that time of the year. When the take way food is consumed, all waste by products of the packaging can be thrown into the Grow-Away bag, and then crumpled into a compact ball, and planted into a shallow hole and sprinkled with a cup of water to aid the composting process. After 3** months, the first shoots of the Grow-Away bag will appear. In the worst-case scenario that the Grow-Away bag is discarded in the street as litter, or into normal trash, or the ocean, the bag and its contents will break down fully within one year.**

As part of the program, we would be able to manufacture prototypes for both the sachets and the ‘grow away’ bag and test them in the relevant contexts. The program would give us a platform to network with other like-minded individuals giving us a platform and access to global ideas and ways of tackling the same problem.

** These time frames must still be verified once we have a prototype of the products.
Furthermore, it would enable us to acquire the necessary expertise to manufacture a prototype of our bioplastics as a first step after which we can do more viability and feasibility testing and analysis. With more funding and expertise we aim to implement all the phases of our solution from the sachets to the ‘grow-away’ bag and in turn revolutionize the packaging of fast food.

Success would be defined, first on a small scale by getting one mall and eventually city to adopt our solution and this could be later be replicated worldwide.

PLEASE DESCRIBE FROM WHERE YOUR IDEA EMERGED

A multidisciplinary team of postgraduate students from the University of Cape Town who had done a foundation course in design thinking worked together to generate ideas for a submission using the design thinking methodology.

Our idea emerged through conducting interviews with users and generating a Point of View (POV) statement based on the user cases provided by IDEO. We then ideated on this POV to generate possible solutions as presented in this document.

TELL US ABOUT YOUR WORK EXPERIENCE:

We are a group of postgraduate students from the University of Cape Town who had previously done a foundation course in design thinking at the Hasso Plattner Institute at the Graduate School of Business.

We have a diverse study backgrounds and experience including, Information technology, Law, Biochemistry, Pharmacy, Sociology, Education and User Experience Design.

PLEASE DESCRIBE YOUR LEGAL AND ORGANISATIONAL STRUCTURE

We function under a team charter for this project however we are working on company registration.
TEAM
Kinsley Ndenge
Andrew Bisagaya
Sarah Atmore
Charl Brandon Souma
Mina Amin Youssief.

INSPIRED BY:


http://www.rainharvest.co.za/2010/05/the-water-hyacinth-problem/


References:

