



LISTAHÁSKÓLI ÍSLANDS
Iceland Academy of the Arts

From the Bones

A journey of searching
new uses for animal
bones in Iceland

Jiaoni Jiao

A document submitted to:

The Department of Design and Architecture, Iceland Academy of the Arts, in partial fulfillment
of the requirements for the degree of Master of Design, 2015.

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Abstract

This study is about using a design method to find new uses of leftover lamb bones from slaughterhouses in Iceland.

As a Chinese designer studying in Iceland, I found great differences in the Icelandic and Chinese food culture, being curious about the fate of animal bone leftover from Icelandic livestock. I started investigate how and whether people use animal bones. To raise questions about the consequences of consumerism, I decided to use waste from the Icelandic food industry as my design material. I see great opportunity in the cyclical system of biological nutrients by creating design(s) through which I can combine my personal cultural experience with the actual and current situation of waste by exploring the use of animal bones as a kind of biodegradable design material.

This essay is following the steps of investigation from whereabouts of each part of Icelandic lamb to discussion of why people stopped using bones and how people used bones in earlier times in Iceland.

In contemporary times, bones are usually turned into powder and used as nutrients for planting. However, by boiling the bones, we can get high quality broth that can feed people, and we also get clean bones. By looking at this technique in detail, and connecting with the Eastern philosophy Samsara which conveys the notion of a never-ending cycle of birth, life, death and rebirth. I found a theory that is to take fresh leftover bones from slaughterhouses, by the way of a recycling system before, we can get food to feed people and a kind of material can cast disposable products. I expressed the concept through a serial of design works which is using the philosophy of Zhuangzi – the harmony relationship between nature and humans – as to show the different status of “entirety – separate – integrate” of bones in nature. Also the experiments for making the design work find arguments to lend credibility to some parts of my theory.

Keywords: waste, food, lamb, Iceland, design, material, recycle

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Table of Contents

1.	Introduction
2.	I question
3.	I investigate
4.	I think
4.1	Artificial food = lab monster?
4.2	Research Question
5.	I try
5.1	History of BSE
5.2	Design concept
5.3	Experiments
5.3.1	Crushing Experiments
5.3.2	Binding Experiments
5.3.3	Shaping Experiments
6.	I tell
6.1	Artistic approach
6.2	Drawings
6.3	Time-travelling stage scene
7.	I found
8.	Bibliography

1. Introduction

“Finish all your dishes, because the farmers work so hard to raise the food for you...”
I still remember my mother telling me this when I was a child. This is a basic common sense that every Chinese kid will learn: never waste any food. I believe this is one of the reasons why the Chinese eat almost everything from the animal; and why Chinese cooks put so much effort in developing food in order to let people accept them. No waste equals utilizing everything from Nature resources that is the earliest understanding of sustainability to me.

As a Chinese designer who is studying in Iceland, I found differences in food culture between Iceland and China. For example, some animal parts do not appear in the domestic market, and I’m was curious about the whereabouts of animal bones as leftover from Icelandic livestock, which lead me to investigate how people use animal bones and opportunity of design work from this culture difference. Because of globalization, consumerism and massive production, getting products from abroad is so easy and convenient, it seems like people stop appreciating what they have, start to upgrade unnecessary material goods, occupy and deplete energy and resources, and discard the products which still have some value. This project comes from the idea that whether there are more values from bones which can be used, and if we are wasting materials.

Sustainability is a very complex concept, it’s involved in so many different areas, but in my view, it’s about finding a balance of human needs between future and present. What I’m looking at is just a tiny spot in the huge universe. I hope this project can inspire people from the Icelandic livestock business to investigate other usage of local animal products, which could be of some business value. Also for designers, there are much possible local natural recourses out there that can be used as an eco-friendly product material waiting for exploration. Furthermore, I hope everyone who sees my work can get the concept of life cycle.

2. I question

I have been in Iceland since 2013, every time I feel homesick I would think about some “strange food” from my hometown, e.g. chicken feet, pig offal, lamb bones and other animal parts which are very hard to find in the Icelandic market. I miss the traditional food market in China, housewives will buy one alive chicken, it would be slaughtered by the shop owner right after being paid, feathers would be sold to craftsman for making duster; the liver and other organs would be fried into one dish; chicken meat would be taken for cold dish; bones would be boiled for chicken soup; wings and feet would be marinated for snack, the whole family would have a great meal with just one chicken. But in the Icelandic market what I see is a lot of “meat pieces” without head and feet packed in plastic bags displayed in giant refrigerators. I couldn’t even reorganize the animal in question without a label tag. I can’t help myself to think about a question with this phenomenon: If the market would need to sell so much meat, which means we have to kill so many animals, then where are the “leftover parts” from those meat pieces products going? Obviously, the sellers on the market tell us local people don’t buy them. I asked local people around me, most of answers were “discarded” or “buried”. Actually, I was shocked: “So Icelanders are wasting food?” This was my first reaction.

To me, waste is an act that people throw away something still useful, but when people define something as a trash, usually because of they haven’t finds the way to use it yet or they have forgot. So according to answers local people gave me, Icelanders are wasting natural resources because of their food culture? And local news keep reporting stories about dumpster divers, it says “A group of people in Iceland hardly spend any money on grocery shopping but manage to feed themselves and their families with dumpster diving, by picking up food from dumpsters outside supermarkets.”¹ So people are not only wasting products from supermarket but also natural resources from livestock? I think I should get to know the truth of this guessing. Interview could be my most suitable solution for investigating the situation.

1 “Dumpster Divers Feed on Discarded Food in Iceland”, Iceland Review online, last modified January 30, 2014, <http://icelandreview.com/news/2013/03/08/dumpster-divers-feed-discarded-food-iceland>.

3. I investigate

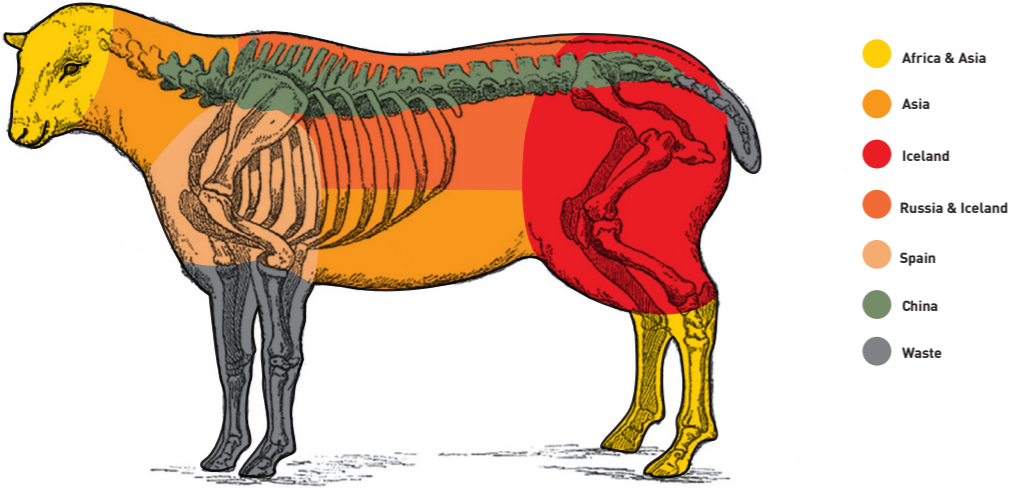


Fig. 1: Mutton is usually sold with bones and sent to different places, only the green spine are sent to China.

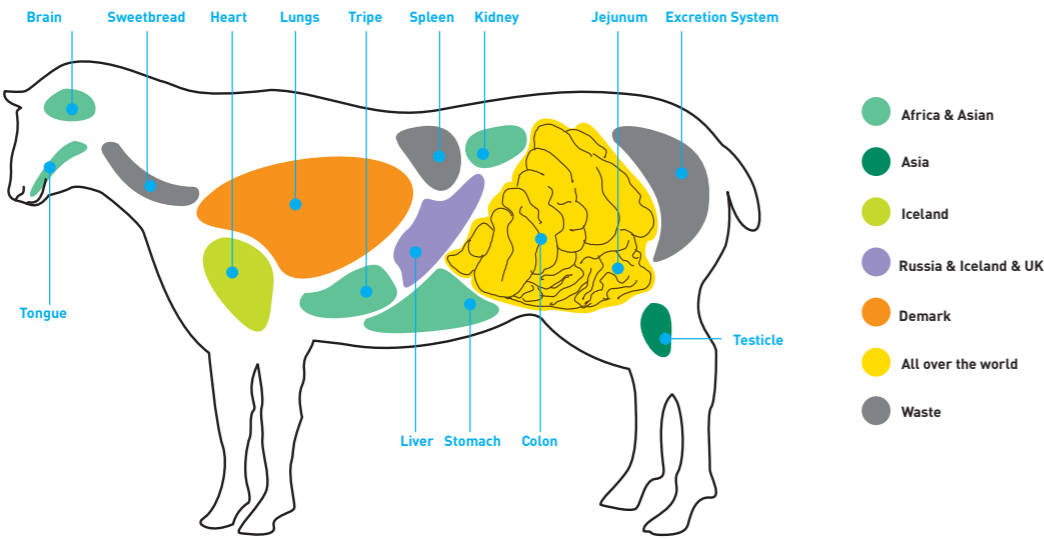


Fig. 2: The lamb’s internal organs are sold to different places except sweetbreads, spleens and excretion systems are put to waste.

As a foreigner who doesn’t know anything but was full of curiosity, I started with official statistic information: I contacted Environmental Agency of Iceland to ask about the fate of animal leftovers. They told me for safety reasons, farm animals are gathered to slaughterhouses to get slaughtered and dismembered; by-products like skin, horn, blood and so on are collected and sent to related processing factories; other useless parts and pieces are considered as waste. For animal-by-products to be considered as waste they have to be landfilled, incinerated, processed into bio-gas or processed into compost. In 2013, 10892 tons of slaughterhouse wastes were generated: 8793 tons of them were landfilled, 94 tons were incinerated, 2005 tons were composted.² When I got these numbers, I still had no idea what exactly those tons of wastes were. I imagined there was a “name list” about those wastes, but unfortunately, no such list was found in the Environmental Agency. I also realized I was asking about the whole livestock industry. This was too wide, even an expert from Environmental Agency couldn’t answer me that.

So I narrowed my context by focusing on the Icelandic lamb, because lamb is most common and also the most distinguishing feature in Iceland. The lambs are entirely reared outdoors. Their natural diet of sedge, willow, thrift, moss, and berries makes Icelandic mutton instantly recognizable for its delicious and distinctive taste.

After several rounds of turnover, I got connection with the manager of slaughterhouse from KS (Kaupfélag Skagfirðinga, one of the biggest meat companies in Iceland) Ágúst Andrússon, part of his job is to find ways to deal with the leftovers of the animals, as far as possible not to waste them. With purpose of making the “name list” by myself, I interviewed him in Reykjavik. At first he told me everything in their slaughterhouse is utilized, there’s no waste, as answer of the question “what are you usually wasting in your slaughterhouse”. Then I started to ask where is every part of lamb going one by one, by pointing out parts from a lamb picture I made (fig. 1 and 2), Andrússon told me most of animal parts are shipped abroad, especially internal organs and bones, they are exported to China and Africa. When I asked whether it is possible to open

² These data were received from the operating landfills, incineration plant and composting plants in Iceland.

up the domestic market for those animal parts ingredients, he shook his head without hesitating, “because we are not used to them” he said. “How do you Chinese use those things?” he turned to ask me.

At this moment, the soup made by my mother came to my mind. She would choose one big piece of fresh lamb leg bone from the market, chop it into pieces, boil it in water for few hours, add vegetables after seasoning and serve the soup with rice. So this nutritious and delicious food was actually unaccustomed to Icelanders?

Actually this soup is very traditional, from ancient times when humans learned how to make tools, they scraped soft meat from animal bones, or cracked the bones to suck the marrow. This gradually developed into this traditional cooking method, nowadays people still enjoy the taste from bones. In fact collagen, proteins and calcium provided by bones and bone marrow as an ingredient is very supportive for the human body. Traditional Chinese medicine even has a theory that eating lamb bones can help improving people’s kidney function.

Except being food, bones are also solid hard materials, from the Paleolithic Age; bone has been used for making tools by virtually all hunter-gatherer societies, even when other materials were readily available. The bone was fashioned into tools such as spoons, knives, awls, pins, fishhooks, needles, flakers, hide scrapers and beamers. They made musical rasps, flutes and whistles as well as toys of bones. Decoratively carved articles were also made of bone such as hair combs, hairpins and pendants.³ At that time bone had been considered as a hard object, until people found the replacement material. Now in some nomadic cultures, people still use animal bones as decoration, and in Icelandic farm culture, lamb bones still a kind of popular toy for children.

Bones also had been considered as compensation to Nature, with myths and rituals of an identical propitiatory significance, in the belief that by being kept together with the soul would return to the bones of the animal, thereby causing it to be reborn. In ancient China, ox scapulae also become a divination tool; people carved ancient language on it. And in Icelandic tradition, people will bury lamb bones into the building wall as sacrifice.⁴ This is probably human’s earliest understanding of the life cycle, to obtain from nature, and give back to nature, and generate new life by nature.

The cycle of life that is called Samsara in Eastern Philosophy, within the traditions of Hinduism, Buddhism, Jainism, Taoism and Yoga, there is the notion of this never ending cycle of birth, life, death and rebirth. Reincarnation means when people died they are going to another world and they will be alive in the other form. It reminds me the meaning of sustainable life: trying to use the resource on our planet indefinitely. When we saw a dumped product, we consider it “dead” garbage, and recycling could be considered as a “rebirth” of the material, a “reincarnation”. That’s also my understanding of recycling, everything in the end will go back to Nature in other form and is reborn in the big system. I’m very interested in this process of transformation, so when I look into the cycle system of bones, I had to guess: before bones go back to Nature, is it possible to change them into other forms? Is it possible to bring this concept to bones' life cycle?

3 Susan K Nelson, "Deer Bone Tools", (2009), <http://www.susankae.com/deer%20poster.pdf>.

4 Albína Hulda Pálsdóttir, "Dýrabein og byggingafornir á Íslandi", <http://hugsandi.is/articles/dyrabein-og-byggingafornir-a-islandi/>.

4. I think

Culture as the reason that Icelanders don't use bones is not convincing me. This does not have any conflict with the Icelandic food culture. Therefore what are people really "not used to"? I have talked to several Icelandic cooks about this problem, they told me in the past local chefs would use fresh bone broth to improve the flavour of food, every chef must prepare a pot of fresh bone broth before starting to cook; but now people just buy a small cube to put into in the water for making soup and many restaurants and canteens are using this bouillon cube. In today's busy life, people live with very fast, they do not have time to spend hours on cooking soup, and bouillon cube is the alternative for people offered by modern technology. Although those small cubes will not cause harm to the human body, they also has their limitations: for example, it is a kind of product concentrated by industrial factory, it contains food flavour enhancer, food additives and food thickening agent and even flavour essence, the nutrition value is far less than natural homemade soup. These products will undoubtedly reduce the production costs of food and beverage industry, to enhance the economic value.

However, food is not just a product that can fill stomach, but also a container of story and emotion. Through food we can tell: Where this material grows? How do people gather it? Who is the cook? What's the relationship between you and the cook? Why is this person cooking for you? How is he or she processing the material? How long does the process take? What does it look like when it is presented? What is the smell? How do you eat it? ... All these details are fulfilled with senses and humanity and make a unique story. "Put love into food," people say. And those stories of touching quality of people, made up today's food culture. The instant food is undoubtedly a challenge to traditional food culture; it brings convenience to people's life, but takes the deep meaning of dining away.

4.1 Artificial food = lab monster?

"Fifty years hence, we shall escape the absurdity of growing a whole chicken in order to eat the breast or wing by growing these parts separately under a suitable medium," these are the words of the great British Prime Minister who played a vital role in the Second World War, Winston Churchill.

In an essay he wrote for Strand Magazine, titled "Fifty Years Hence," he predicted that in 50 years we will start to grow only the edible parts of an animal in a special medium, rather than growing and slaughtering a whole animal only for some of its parts.⁵ Churchill's word encouraged many scientists to put an effort in developing artificial meat and food. It's hard to imagine what would happen if people really produce chicken wings separately. But when the rumour of "KFC spider chicken"⁶ came out, people believed and panicked. The rumour is still spreading today through the Internet because people believe it's so unnatural and sick.

In my opinion, Churchill was trying to describe a highly advanced future that with rich resources developed by human technology in a background of war turbulent and lacking resources. In the time of rich resources, today hunger problem still exist. Aiming to solve this problem of food shortage efficiently and sustainably, in 6TH of August 2013, Professor Mark Post of Maastricht University presented a burger made from Cultured Beef in front of an invited audience in London. Under the funding by Google co-founder Sergey Brin, the team spent 250,000 Euros producing 28 g of Lab-grown beef, but it tasted more like "an animal protein cake"⁷. "Cows are very inefficient meat producers, they require 100 g of vegetable protein to produce only 15 g of edible animal protein," Dr Post told the Guardian before the tasting event. "So we need to feed the cows a lot so that we can feed ourselves. We lose a lot of food that way. [With cultured meat] we can make it more efficient because we have all the variables under control. We don't need to kill the cow and it doesn't [produce] any methane."⁸

5 "A Reflection of New Harvest's Achievements: Bringing Winston Churchill's Prediction to Life" 27 Jun 2014, <http://www.new-harvest.org/2014/06/a-reflection-of-new-harvests-achievements-bringing-winston-churchills-prediction-to-life/>.

6 KFC spider chicken, the rumor says KFC 's chicken wings are from mutant animals that have 6 wings and 6 feet. A story citing a University of New Hampshire study claims that the federal government forced KFC to shorten its name from Kentucky Fried Chicken when it stopped using "real chickens" and started using these tube-fed "genetically modified organisms."

7 American food writer and author of the book Taste of Tomorrow, (2012) Josh Schonwald, who has tasted the burger, later in the tasting he described the texture as "like an animal protein cake".

8 "Google's Sergey Brin bankrolled world's first synthetic beef hamburger", Alok Jha, Last modified

Undeniable the Lab-grown beef can help decreasing number of slaughtered animals, but once the lab-grown meat get into production, it will encourage consumerism. In this world of massive production, globalization and consumerism, it's so simple to buy things, and so easy to discard them. Growing meat in the lab just tells the consumers that there's no need to worry about lack of Nature resources, since we can make as much as we want in the lab. Just like the publicity of bouillon cube says, it comes from natural material, and it's a safe nutrition-condensed harmless product. The act of buying to eating or discarding has become too fast and shallow in order to think about the real meaning behind. In the end we will stop thinking about meaning of life; everything has to be convenient and efficient.

In Japanese legend: There are seven gods living on every grain of rice. They tell people every grain of rice is worth cherishing, these seven gods do not just represent human effort, but also the time of 4 to 6 months for growing the rice, natural elements in these 4-6 months, like winds, air, rain, etc. It is a collection of various elements of nature; shouldn't we slow down our steps, and appreciate those efforts and creature of nature? If we blindly pursue efficient, then how can we find the seven gods behind a lab-grown rice? So what can I do as a designer who really cares about nature resources? I started to ask myself and decided to use it as my research question.

4.2 Research Question

In Iceland, animal bones are usually thrown to waste – both in slaughterhouses and in individual households (after consumption of meat), so my research question is: How can design intervene and come up with suggestions for making use of waste products with the aim of changing people's attitude to recycling nature resources?

on 22 May 2014, <http://www.theguardian.com/science/2013/aug/05/google-sergey-brin-synthetic-beef-hamburger>.

5. I try

"Use different eyes to see resources, to create value through transforming materials into different shape / form", that was what I thinking about the transformation of material in samsara. When I saw a bone, I saw a nature creation as a kind of sculpture united by chemical elements. I want to explore whether it is possible to reform these elements into a new sculpture that can be used as replacement of plastic, paper or clay. In the beginning, I was on the purpose of "finding new use of Icelandic bones", I decided to look at how bones have been utilized in modern times:

5.1 History of BSE

In 1960s, bones had been used as many different forms but mainly for meat and bone meals (MBM), MBM was wildly used for animal feed until the breakout of bovine spongiform encephalopathy (BSE, or better known as Mad Cow Disease) from the United Kingdom spreading all over the world in 1980s.⁹ In most parts of the world, MBM is no longer allowed in feed for ruminant animals. However, MBM is still used to feed monogastric animals (animal which only has one stomach). And it is widely used in the United States as low-cost meat in dog food and cat food.

After the BSE crisis, people started to keep bones at distance. Millions of cattle were slaughtered, and almost half a million tons of dried MBM, the cause of the disease, was stockpiled in secure sheds. Glanford Power Station in UK was re-commissioned in May 2000 to burn them. It cost a gate fee for the fuel it burns, which would have otherwise been disposed of using conventional landfills. MBM has around two-thirds the energy value of fossil fuels such as coal, and has been labelled carbon neutral. Despite producing "green energy".¹⁰ But this way of using bones releases a lot of carbon, which is another form of load on nature.

⁹ First BSM case break out in UK in 1986, then the virus had spread to all over the world. "Mad Cow Disease Fast Facts", CNN Library, Updated at January 11, 2015, <http://edition.cnn.com/2013/07/02/health/mad-cow-disease-fast-facts/>.

¹⁰ BBC environment correspondent Tim Hirsch, "BSE carcasses burned for electricity", last modified June 3, 2000, http://news.bbc.co.uk/2/hi/uk_news/775324.stm.

Bones are composed of organic and inorganic material, organic are mainly protein, people extract collagen and gelatine from them for medicine, food or cosmetics; inorganic are calcium and phosphor, nutrients essential for the growth of plants, most of bones are made into fertilizer. BSE keeps people (especially Europeans) at a distance from bones. Most people use extracted nutrients instead of direct contact to bones. Bones as fertilizer back to nature in this way give me inspiration.

5.2 Design concept

Getting inspiration from the biology nutrient cycle system¹¹ (Fig. 3) in book *The Upcycle: Beyond Sustainability*,¹² I made a new picture (Fig. 4) to show how animal bones are recycled in nature, I added a process of crushing bones into powder, that also explained how people utilize animal bones. So from the branches of circle A of Fig. 5, fresh bones are cleaned by boiling (B), the idea I got is after clean bones being crushed into powder, is it possible to reform the bone powder as product material (C)? Can results of process B and C that are the bone broth and the reform material combine into a product? And is this product still biodegradable and could even become fertilizer again after being used? If so, this bone powder can be a replacement of plastic in many ways, and it can bring more economic benefits without harming the environment.

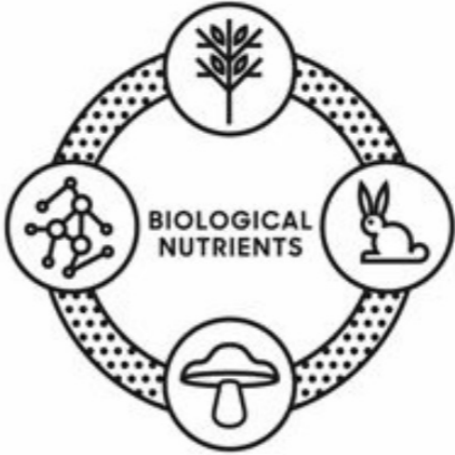


Fig. 3: Biology nutrient cycle system.

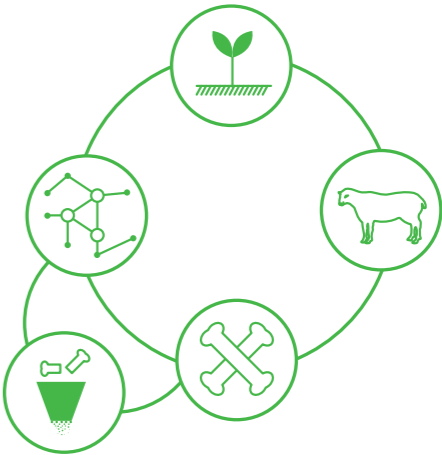


Fig. 4: Bone nutrient cycle system.

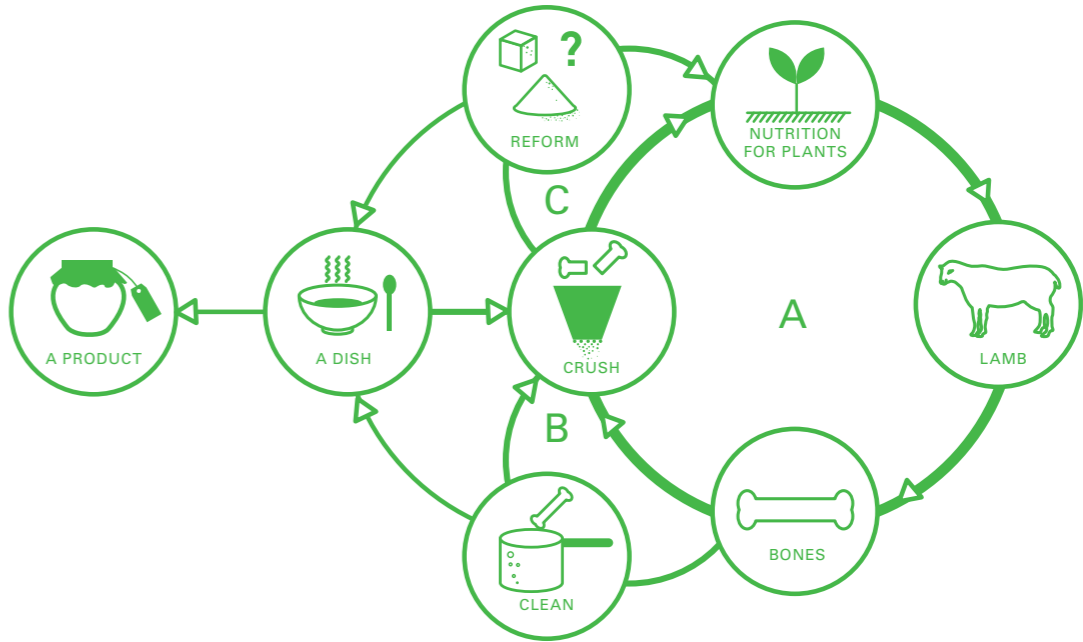


Fig. 5: Branches from bone nutrient cycle system.

¹¹ In this book the authors introduced a picture that shows a biology nutrient recycled by transforming from plants to animals then to fungi to microorganism finally back to plants.

¹² William McDonough and Michael Braungart, *The Upcycle: Beyond Sustainability--Designing for Abundance* (New York: North Point Press, 2013) 19.

5.3 Experiments



Fig. 6: Bone broth build 8 hours I made, with salt and coriander, had been served on the first presentation in school.

For testing my theory, I did a series of experiments, including cooking lamb bones (taken from lamb leg meat product) from local supermarket for 8 hours, taking off fat and tissues from bones, drying the clean bones, crushing bones by hammer and kitchen grinder. In fact this series of experiments is very amateur; it's just a DIY test running by curiosity without scientific bases and professional measurements. Though I proved I can get clean bones and broth by boiling fresh lamb bones, and I can use machine to grind the bone powder through these amateur experiments, however, the experiments could be dangerous: first, I didn't use professional equipment. I was using kitchen utensils handling biological material at a rough condition. Once lamb bones start to decay, they can bring unbearable smell and bacteria as well as viruses. Another thing is I was using hammer to crush the bones, it could bring in metal or other tissue from hammer to bones, and many of other issues that I have no awareness. As a designer who has background of art, I feel my science knowledge is too little. I need not only professional equipment and lab, but also professional experts' cooperation.

5.3.1 Crushing experiments

Just as Paola Antonelli said in *BioDesign*: “*Design is not what it used to be. In schools and in studios, in corporations and in political institutions, designers are using their skills to tackle issues that were previously out of their bounds, from scientific visualization to interfaces, from sociological theories to possible applications and consequences of nanotechnology. They do so by teaming up for every case study with the right experts, who often seek designers’ help in order to connect their theories with real people and the real world.*”¹³ Being a designer let me see the real world, I care about social issue, and I did background research, also trying to find out solution for it. But if I really want to connect my work to the real world, I have to team up with people from different area. Design is like a binder to connect the various aspects of technical knowledge together, designers should be flexible to adapt to various environment. Just like Sim Castle said: “*To really fulfill a technology to its potential, it must be adapted to a human user; ...It is not the discovery or even the technology that starts a revolution, it’s the product that brings the technology to the masses.*”¹⁴

Innovation Centre of Iceland encourages innovation and promotes the advancement of new ideas in Icelandic economy by providing active participation and support to entrepreneurs and businesses. With their help, I found the right machine which can help me crush bones into powder efficiently (see Fig. 7 & Fig. 8).

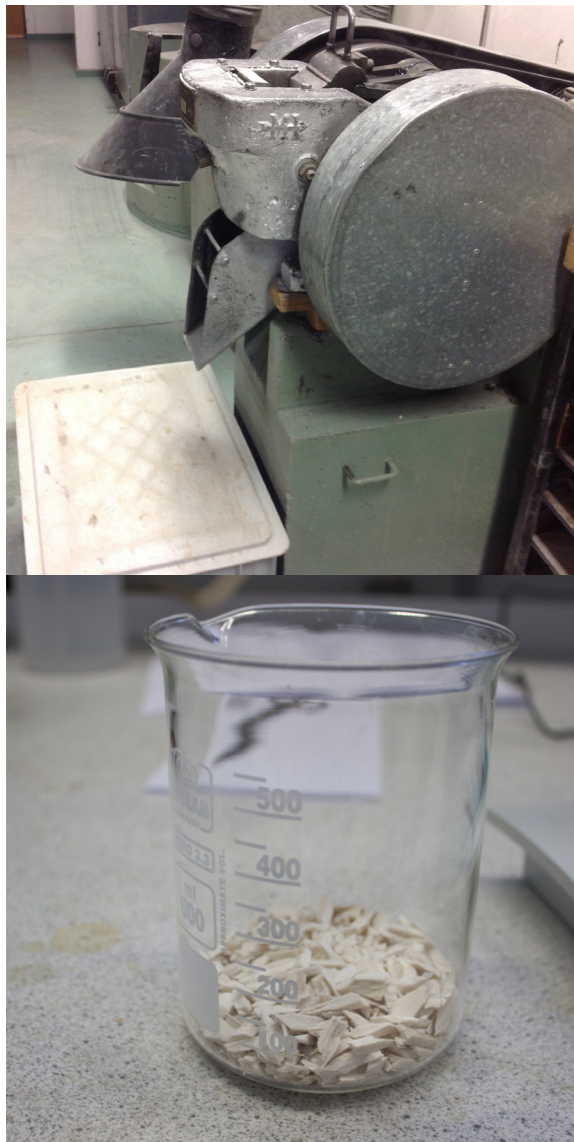


Fig. 7: Hammer meal for stones can crash bones into smaller pieces.



Fig. 8: Ceramic grinder can grind small pieces into very fine powder.

¹³ Paola Antonelli , “Vital Design”, in *Bio Design: Nature, Science, Creativity*, edited by William Myers, (London: Thames & Hudson, Limited, 2014), 6.

¹⁴ Sim Castle, “Why the Synthetic Biology Movement Needs Product Design”, *BioCoder Summer 2014*.

5.3.2 Binding experiments

The first idea about method of reforming bone powder is like pastry-cook, mix the powder with liquid then shape it. This liquid should be a kind of binder to structure the material, but what kind of liquid should I use to make it strong enough?

At the beginning I was thinking about using alginate, which is a natural material like jelly glue, and this natural resource is very rich in Iceland. Maybe it will work with bone powder, I was guessing. I got some sample of Protanal GP 5450 which is a kind of sodium alginate from FMC company with their suggestion. Unfortunately, after several laboratory experiments with professional mixer (see Fig. 9) with help from a scientist of the Innovation Centre, bone powder and alginate were merging together at beginning, but alginate is a very strong water absorption material, once I tried to dry synthetic material, it had shrunk sharply – almost five times smaller than before, and even cracked (see Fig.11). I tried a variety of combination of different proportions even combined other chemicals such as calcium and phosphor; it did not solve the problem. It seemed that alginate was not what I was looking for.

Maybe I should just mix them with water really like pastry making, and see how it goes. First I put 12 ml water into 10 g of bone powder then had them mixed and put them into a silicon cupcake mould (like Fig. 10), after 12 hours of drying at room temperature and I got my first intact shaped prototype (pro. 1, see Fig. 12). This is a piece of solid that looks like biscuit with a lot of small holes, probably the gelatine from bone itself helped binding work. From pro.1 I saw hope although it's just a tiny piece of very rough material. Through this, I think I can use this method to continue my next step of experiment - shaping.

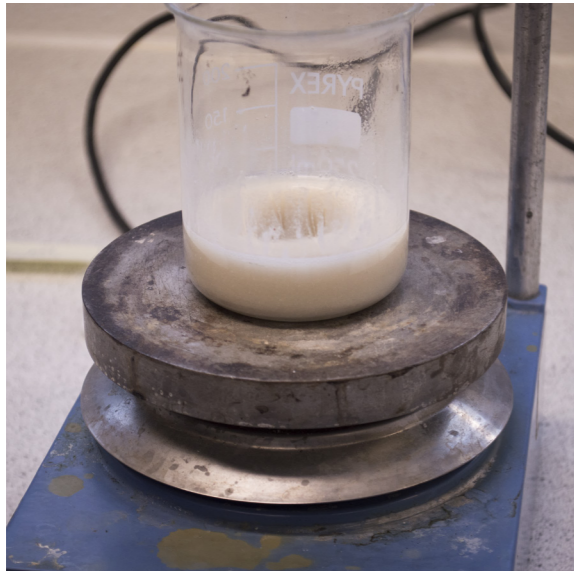


Fig. 9: Magnify mixer in Innovation Center is mixing alginate and bone powder together.



Fig. 10: Sillicon mold.



Fig. 11: When alginate shrunk, material was cracking.



Fig. 12: Prototype 1 formed very well.

5.3.3 Shaping experiments

Like what I did as pro. 1, I put the bone paste into a silicon mould in order to keep the shape. So if I want to make a container from that material, I would choose ceramic techniques that I am familiar with.

First I made a cup by sculpturing clay (Fig. 13) and modelling with alginate AL PR (not the same type with binding experiments), pour the bone paste into the mould and wait for it to form (see Fig. 14). While waiting for prototype 2 (pro. 2) to dry, I used leftover bone paste to make another prototype that is a pro. 3 by different casting way: I tried to cover bone paste around a disposable plastic cup, which is possible and could get much finer shape in theory (see Fig. 15).

When I opened up those 2 moulds, alginate mould casted a cup successfully, plastic cup mould cup cracked into pieces during the process of drying. Alginate mould is kind of rubber-like material. There is a certain degree of flexibility, when pro. 2 was removed out from the mould, bone paste was easy to take off from the mould without sticking to the inside of mould. But alginate also has some limitations: because it is a high quantity water absorption material, water will come out from alginate when it getting dry, then cause bone paste not easy to become dry and build up the solid, and at the same time draining mould will shrink deformation, it is easy to squeeze the bone paste inside. If this situation is to produce a relatively thick container this process is okay. But if the shape is too thin, it can easily get damaged by squeezing.

During I was waiting for pro. 2 and pro. 3, I tried to fuse bone paste and a small piece of a dry bone from lamb toe together as a cap for the cup – pro. 4 (see Fig. 16).

Pro. 2 and 4 were successfully carved away from moulds without damaging. Then I poured water into pro. 2 to test if it can contain liquid, but a part of water were absorbed by the material, after the water got drained, the surface of pro. 2 started to crack. This appearance indicated that bone powder needs a kind of stronger adhesive to increase density of the material so the product can contain liquid.

For improving the effect of my exhibition, I tried a new recipe to make container for soup loading - prototype 5 (pro. 5), I add 50% of the plaster into bone paste for making a finer shape bowl, the outcome of moulding was very good-looking, this synthetic bone product has both smell and colour from bones, also solid as plaster - though it's not completely hard as plaster in the same level, but it can be used to contain liquids.



Fig. 13: Clay cup for moulding.



Fig. 14: the mold for pro. 2.



Fig. 15: Another way of casting pro.3.



Fig. 16: Fuse bone piece and bone paste together.



Fig. 17: On the left Pro.3 crached into pieces, but Pro. 2 on the right worked.



Fig. 18: Using Pro.2 contain water for 2 minutes, Pro. 4 by the side.



Fig. 19: Pro. 5, size: 15x15x10cm

Although pro. 5 can contain liquids much better than prototypes before, but the extent of its firmness still cannot reach my ideal level as a food container. More important, ordinary craft plaster is not biodegradable material, is not really fit the concept of the biological cycle system, this technical problem needs to continue to study and explore after. But for sharing my concept, pro. 5 is sufficient to play the role of main character at my exhibition stage.

6. I tell

Sharing idea with related or targeted audience can always bring feedback and inspiration. I showed my idea to Ágúst Andrússon, and tried to get support of experiment material that is lamb bones from their company. He was very willing to answer my questions, and helped me to complete the info graphic of the lamb division map I drew. It is worth mentioning that, he told me there are some lamb bones they will bring to waste (See Fig. 3) namely the foreleg shanks. Because the meat from this part will be taken off by the process of de-hairing and it cannot be sold, the company has to pay 14 ISK for each kilo in order to discard them. This could be the perfect match material for my project.

About my concept of crushing bones and reuse the bone powder Andrússon showed his support by giving me 10 kilos of bones for experimental material. Furthermore, he introduced me to a “soup expert” who is cooperating with KS for a lobster soup product, his name is Steindór Haraldsson. Haraldsson used to be a chef and is now a food scientist, he is the co-owner of the food company Marlce and a lobster soup he is making now is exported to the Japanese market. He was interested to my project, and we discussed about how enzyme technology could work on bone broth making, and he gave me many technical suggestions regarding my experiments based on his experiences. As he said, he is planning to step into the meat soup business, if KS can provide fresh leftover lamb bones, Marlce factory can use enzyme to make broth product, and clean bones can be used in package production as my idea showed, it’s a perfect win-win connection in industry. This conversation really encouraged me to keep going on the project. I also realized the limitation of my own capability on technology at the same time. Besides, the possible connection between companies let me feel I could be the initiator of this project and I should put more efforts on expressing my concept and idea at this stage, telling more people about the circle of life instead of waiting for scientists’ cooperation. This could help me get more social attention and connect more people together who have the same idea. How to communicate with my audience, to let the audiences understand my concept in a tacit and simple way became the question I have to face.

6.1 Artistic approach

I want to design a set of new food, from ingredient and eating ritual, to atmosphere of surroundings, so from this orchestrated “stage”, by interacting with it, people can come to realize the cycle of life, and be grateful for the gift of nature’s hard work.

The traditional concept of nature in Western countries often is based on the combat between human society and nature. It believes that the process of human society development is to conquer nature. But in Chinese Taoism philosophy, one of the explanations of “天人合一”¹⁵ (harmony between the nature and human) is human being and nature should be connected, that is human and nature are essentially the same, so people should follow the law of nature, to get harmonious coexistence. This sentence translated word by word means “human and nature combine into one”, the key of this philosophy is “合”, in here means “integrate”, also means “harmony”. Chinese traditional life tells that people were pursuing this harmony and combination a lot, for example housing decoration should seriously consider the combination of elements.

I want to use this philosophy as my artistic approach, to make a package from bone powder for containing bone broth, which absorbed from lamb bones. The process would be entirety – separate – integrate, which refers to the cycle of nature process (see Fig. 20).

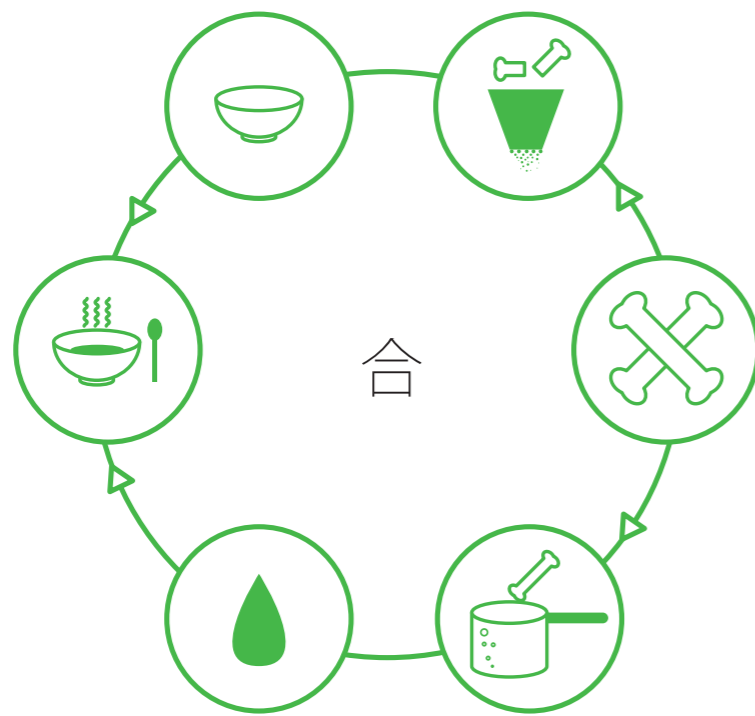


Fig. 20: Entirety - separate - integrate

¹⁵ Chuang-tzu, Zhuangzi (book), late Warring States period (3rd century BC).

6.2 Drawings

First I made three illustrations (see Fig. 21) to express my personal relationship about lamb bones, first one is the lamb which is a hairy alive creature; second one is the bone broth that providing flavour and nutrition to people; third one is the fragments, which shows a hard piece of bone had been crushed into fragments, and broke into pieces again after being reused.

These three illustrations are creating an artistic atmosphere to the audience at the exhibition, also providing a kind of resonance to feel the three different stages of the lamb as I felt from them.

6.3 Time-travelling stage scene

I put the soup I cooked from the bones in the bowl that was also made from bones. Then I brought them to the exhibition hall. In front of my three illustrations I stepped on a piece of turf representing nature. I had the soup meal. This performance was photographed and became the fourth picture on the wall to the audiences as a mystery clue (see Fig. 22 & 23).

Instead of showing a perfect product to the audience, I choose to show a time-travelling picture which is the ending of the story -- reborn. Bowl fragments covered with moss are left on the turf (see Fig. 24). The growing back of real green grass and moss is telling people that this material is providing nutrients to plants. As a stage scene to compare with the fourth picture on the wall, this is telling people what happened one or two month after I had the soup on the turf. Next to fragments is one of my hand-drawing Samsara (cycle of life) of bones on a sketchbook (see Fig. 25), which gives people more clues to understand my concept, and thus more understanding what is happening at this stage.

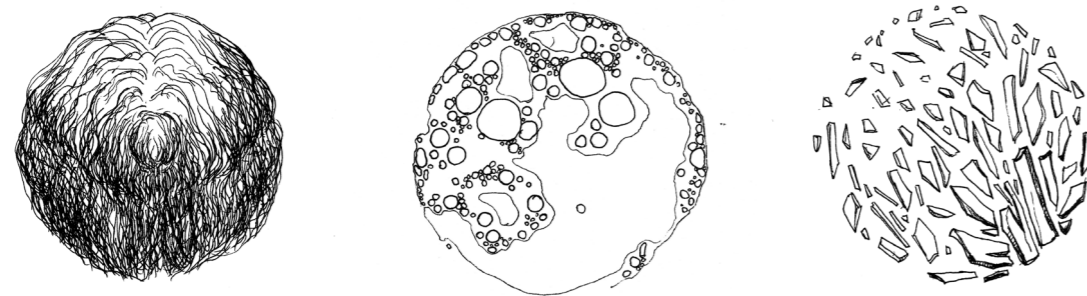


Fig. 21: Sketches of three status of lamb.



Fig. 22: Picture of Me drinking lamb broth in the exhibition hall.



Fig. 24: Bowl fragments grows moss.



Fig. 23: I left the bowl on the turf.



Fig. 25: The sketchbook for showing people the concept.

7. I found – conclusion

Through this project, I found that there is indeed possibility of using lamb bones as design material, especially with the technique of ceramic mould. The synthesis material of bone and water is a kind of a weak structure with rough surface, it cannot contain liquids, but it can be solid under some limited conditions. Further research is needed such as whether the material could again become fertilizer after being used and how to increase the density and the strength of the material. This needs to be further developed and adjusted. Never the less the material has at this stage demonstrated its potential for further development.

On the other hand, lamb broth a beneficial product for the human body, extracted from an abandoned ingredient -- bones, can become an economically valuable product. Bussiness people talked showed their interested after they saw the possibility, this means bones are no longer waste in their mind, they can be material that bring economic benefits.

If this research develops into a production phase, related companies can link up as cooperation for mass production. Also it can be brought to market through small-scale chain restaurants and retail shops.

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