A3 KU VISION PITCH 2022 研究実施・計画書 Research Execution / Plan Form

DEVELOPMENT OF VALUE-ADDED BISCUITS PRODUCED FROM EDIBLE FOOD WASTE (REDUCE FOOD WASTE OF BANANAS USING 3D FOOD PRINTER)

BACKGROUND

Food and postharvest loss-waste have a negative impact on food and fresh foods security for poor people, food quality and safety, economic development, and the environment.

46% of fruits-vegetables became **loss-waste** in the world (FAO, 2016)

13% of fruits-vegetables in East-Southeast Asia lost in **wholesale & retail** (FAO, 2019)

27% of fruits-vegetables wasted in the world during **household consumtion** (FAO, 2021)

Why postharvest products being lost/wasted?

1. Improper postharvest handling and storage.
2. Defects.
3. Unusual shaped.
4. Unsold.

How the effect of postharvest loss/waste?

1. Shorter shelf life.
2. Product value and price drops.
3. Become waste and affect the environment.

How to reduce postharvest loss/waste?

1. Assess maturity.
2. Avoid mechanical injury.
3. Store properly.
4. **Apply treatment and technology.**

METHODS

Objectives

Reduce food loss-waste of unsold bananas to become ultra-processed food using 3D food printing. The detailed objectives are as follows;

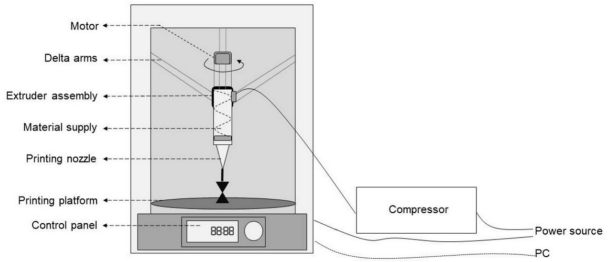
1. Analyze the most appropriate nozzle size; nozzle distance; printing and motor speed.
2. Investigate the best ingredient formulation for biscuits.
3. Study and evaluate the quality of the final product.

Setting, Formulations, Evaluations

3D Food printer setting

Nozzle size (mm)	Nozzle distance to the printing platform (cm)
1. 0.8	1. 5
2. 1.2	2. 10
3. 1.6	3. 15

Printing speed (mm/min)	Motor speed (rpm)
1. 400	1. 180
2. 600	2. 360
3. 800	3. 540



(Souce: Anukiruthika et al. 2020)

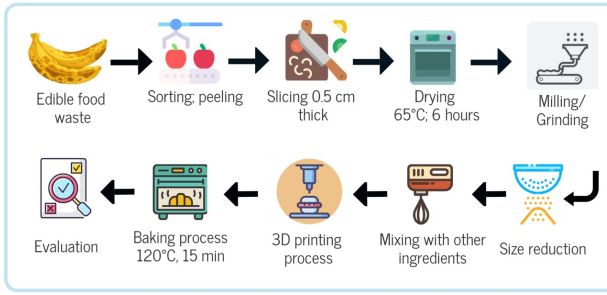
Formulation of banana (%)

0; 10; 20; 30; 40; 50

Evauation

1. Proximate (water; ash; protein; fat; carbohydrate).
2. Firmness.
3. Color.
4. Thickness; diameter.
5. Hedonic test.
6. Best trestment: TOPSIS-Shannon entropy.

The overall process



EXPECTED RESULTS

- 3D printed food will be revealed to have improved structural features.
- The higher formulation of bananas will influence the color and physical-nutritional characteristics of the final product.
- The hedonic test will show the positive potential of the final product.
- Products that are made from food waste can increase the economic-functional value; reduce the percentage of postharvest loss-waste in the supply chain; protect the environment.
- The 3D food printing technology has the potential to be used in low-cost, and sustainable foods.

Food loss is defined as the decrease in the quantity or quality of food resulting from decisions and actions by food suppliers in the supply chain. Meanwhile, *food waste* happens in retailers, food service providers, and consumers (FAO, 2019).

応募者氏名 / Applicant Name	**Laras Putri WIGATI**

カブトガニが人類を細菌汚染から救う ～**世界一**の細菌検出薬開発を目指して～

二億年前から姿を変えない「生きた化石？」
（独自の進化が明らかにされている！）

カブトガニ体液

細菌混入（グラム陰性菌）

凝固する！

○ 細菌はヒトの血液に入ると重篤なショックを起こす（緊急性の高い治療になる）。
○ カブトガニ体液は極めて**微量**の細菌に反応して**瞬時**に凝固する性質がある（左図）。この性質を生かし、カブトガニ体液は、国の法律（日本薬局方）で、ワクチンなどの**医薬品や医療器具の細菌汚染検査に利用**されている。
○ カブトガニは絶滅危惧種で、**今後、天然資源が枯渇しかねない。**

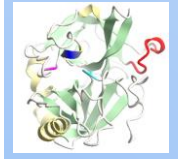
＜これまでの研究＞

○ **ヒトの培養細胞**を用いて、凝固に必要な因子（タンパク質）の**合成に成功**！
→カブトガニから体液を採取する必要がない！
○ 合成した因子の**高機能化**に成功！
→高感度な細菌検出薬に応用可能！

【発表論文（国際誌・査読有）**】**
・Yamashita, K. *et al.*, *J Biol Chem.* 2020 **日本比較免疫学会・古田優秀論文賞**（九大プレスリリース有）
・Yamashita, K. *et al.*, *J Biochem.* 2021（九大プレスリリース有）

＜今後の研究（製薬企業と連携して推進する）＞

○ **瞬時に凝固する**カブトガニ体液の**成分**に注目！カブトガニ体液は生物種にしては豊富な二価金属イオン（Mg^{2+}, Ca^{2+}）を含む。
→二価金属イオンの添加によって合成した因子の機能が向上した！



○ **AI（人工知能）** によるタンパク質分子の立体構造（形）予測ソフト（AlphaFold）を利用！
→AI による非常に精度の高い分子の形の予測を利用して、因子の高機能化に必要な改造を計画する！
○ **カブトガニの研究者は世界でもとても少ない**ため、カブトガニ以外の生物種（ヒト、ハエ、魚など）で似た因子を探し、形や機能を比較して、 応用できるアイディアを探し出す！

○ 多様な生物の基礎研究や情報科学と連携する点が**極めて独創的**！
○ 高感度な細菌検出薬の開発は、**世界中の医療に貢献するイノベーション創出につながる**！さらに、カブトガニの保全にも役立つ！

応募者氏名 / Applicant Name	**山下　啓介**

胎児期は脳神経幹細胞から神経細胞が絶えず産み出され
脳が形作られる大事な時期である

https://www.babycenter.com

母子感染により
胎児期の脳に細菌が感染すると

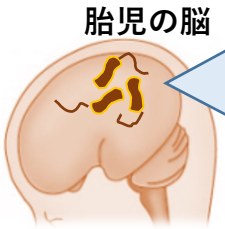
・難聴・白内障 (風疹ウイルス)
・水頭症 (ジカウイルス)
・発達遅延 (インフルエンザウイルス)

産まれてくる子供に重篤な障害が・・・

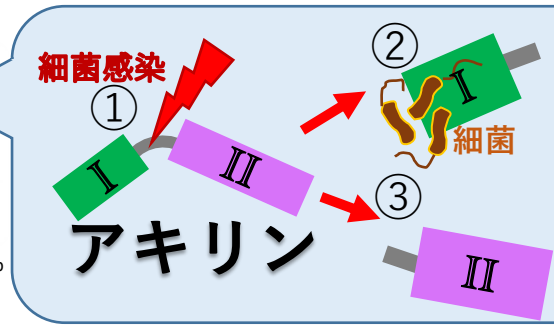
胎児脳の細菌感染に有効な治療法は限られる、、

そこで、“アキリン”は胎児の脳を細菌感染から守るバリアとして働く (研究タイトル)ことを見出した

アキリン(Akhirin) とは・・
アキリンは本研究室が同定した分子である。アキリンは脳の発達期に神経幹細胞に隣接するように発現し（下図）、神経幹細胞の増殖を制御し、脳の形成に関与する。脳の形成が完了するとアキリンの発現も消失する。



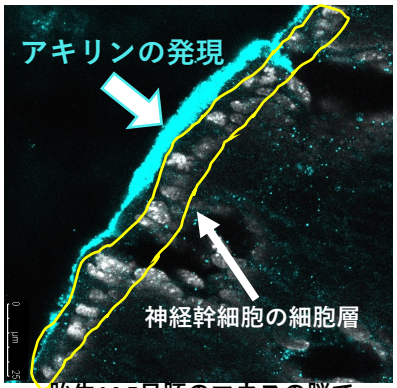
https://sites.duke.edu/apep



① 脳内に細菌が感染すると
アキリンは切断をうける

② 遊離した【Ⅰ】は細菌に直接結合し、
細菌を隔離し細菌感染拡大を防ぐ

③ 【Ⅱ】は炎症を抑える免疫反応を
刺激する



胎生14.5日胚のマウスの脳で
アキリンは神経幹細胞の表面を
バリアするように発現している

アキリンは創薬事業への発展性がある

・アキリンは細菌感染後の炎症抑制剤として応用可能
→細菌感染後にアキリンの過剰投与で感染後の炎症や後遺症が緩和されることが期待
・アキリンが発現している他の組織にも応用可能
→アキリンは脳だけでなく眼・脊髄・精巣などの組織にも発現する

COVID-19やサル痘などの感染症から胎児脳の発達を守る
妊婦が安心して出産を迎えられるような薬剤の開発が期待される

応募者氏名 / Applicant Name	**工藤 三希子**

Background: Inspection of cargo and imported products at the borders of a country is a crucial issue for any government. There are lots of problems that make it impossible to inspect all cargo, especially huge containers, arriving at the ports of a country. Recently, inspection systems based on reconstructing the cosmic-ray muon's tracks while passing through a material have been very promising to address almost all issues regarding inspection, especially nuclear materials, which can be detected in this system after about 2 minutes of inspection. Muons are particles like electrons but with a mass of 207 times greater than that. These particles are continuously produced in the upper layer of the atmosphere and provide a free, hazardless, and worldwide available source. In the inspection systems, the position and direction of muons before the inspection area and after that are recorded, and based on the detected changes, the materials in the region of interest are identified. We found one issue in the current systems that is using some magnets in the inspection area might led to a wrong detection in the system.

Objectives and method: The objective of this research is to propose an essential upgrade to the inspection systems based on cosmic-ray muons by adding a known magnetic field to identify muon charges and also two more detection layers.

Expected results and Research plan: In the first step, simulations will be performed to prove the bug in the inspection systems, and based on that, we are going to design and build our prototype inspection system on a small scale and then propose our system for inspection at borders. A new analysis method is required, and it will be developed by the authors. We will add a feature to the system that can identify if there is a magnet in the inspection area or not, and if so, a detailed inspection is required.

Impact on society: Radiation hazards to society are one important concern. It is not only harmful to the people present in society, but it will also harm the next generation by causing mutations. Also, as the target of muon-based inspection systems is to detect any material that is defined as forbidden materials by the government, the bug in the system might affect the economy of the country, and people's jobs and income might be influenced by forbidden imported goods.

Commercialization: Some big projects in the field of using cosmic-ray muons for inspection purposes are sponsored by different countries worldwide, and recently some companies have been established to build and sell these inspection systems. We believe that with the support of Japanese companies like Toshiba and Mitsubishi Electric that have already expressed their interest in these systems, we can build our own inspection system and also export the required technology to other countries to upgrade their current working systems.

応募者氏名 / Applicant Name	**BASIRI HAMID**

A21 KU VISION PITCH 2022 研究実施・計画書 Research Execution / Plan Form

Title: Automatic reconstruction of semantic 3-Dimensional models of existing buildings using laser scan

Concept note

- This research deals with reconstruction of as-built status of existing buildings using point cloud generated from laser scanners.
- Study aims to produce a novel approach using correlation of geometrical positioning and connectivity of generic building elements in a point cloud.
- The correlation can support construction of algorithms for automatic recognition and segmentation of individual structural elements, followed-up with automatic conversion into Building Information Model (BIM).

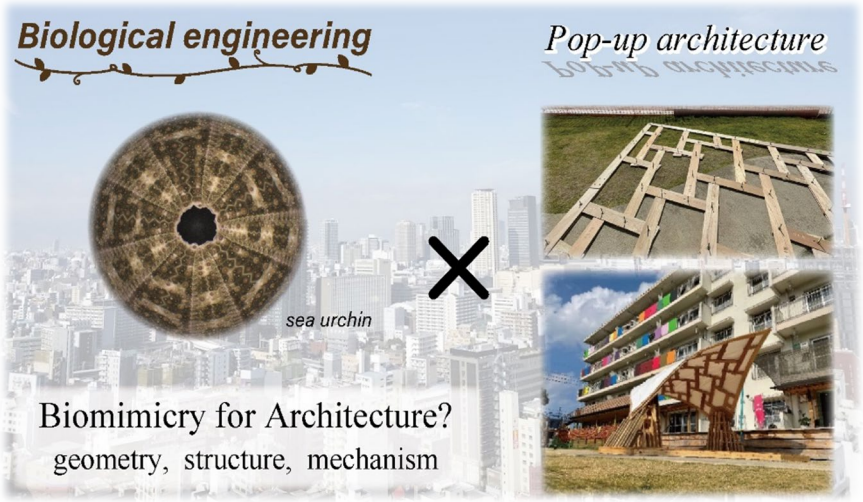
Importance and Impact to society

- Manual reconstruction of 3D model of a single building normally takes up 1 to 3months but using laser scanning it can potentially take about 3 to 7days only.
- Result of this research will accelerate rapid renovation of large stock of existing old and defective buildings which often lack CAD drawings and/or 3D-BIM.
- Also, due to speedy reconstruction of 3D-BIM of existing buildings, developers can opt for renovation instead of construction of new buildings which can avoid for expensive demolitions and carbon emission by conserving natural resources.

Commercialization and implementation plans

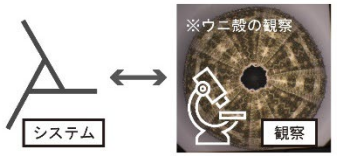
- This research is based on algorithms which can be fixed in a computer software.
- It is primarily a point cloud processing software which can be applied in two packages:
  - ❑ Downloadable software in one time payment and install on a computer;
  - ❑ Cloud-based software on a plan subscription.
- Registration of patent and copyrights for the software
- Enter into exclusive agreement with prominent companies producing laser scanners and BIM software in order to provide an optimum data integration.

応募者氏名 / Applicant Name	**NTIYAKUNZE, Joram**



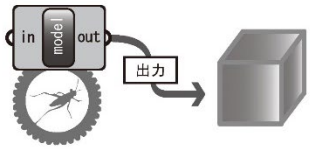
i）構造システムと対象生物のモデル化

・模倣対象生物のモデル化および定式化
・構造システムの形状決定方法に落とし込む



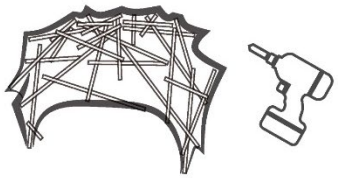
ii）ビジュアライズシミュレーション

・コンピュータ上での 3D モデル化とシミュレーション
・出力結果を視覚的に即時に反映してフィードバック



iii）実寸モックアップ制作・実験

・スケールアップした際の問題点や安全性の検証
・シミュレーションとのずれの原因を考察



❑建築分野における展開構造物とは？

平坦もしくは折りたたまれた小さい状態から、
形状を変化させることで大きな空間を作る架構物


相互支持による展開構造物「木羽」

●メリット

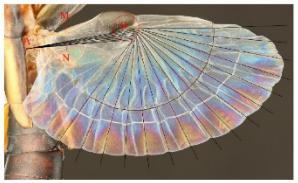
・施工性↑： 立ち上げ時の簡易化
・運搬性能↑： コストを低減

✖課題

① 駆動箇所の脆性： 強度と安全性
② 設計方法の複雑化： 部材の干渉

❑生物模倣工学 (Biomimetics Engineering) の応用

生物の構造や機能から幾何学的な特質を読み解き、
建築分野における展開構造物の課題解決を目的とする



Saito, Kazuya, et al. "Earwig fan designing: Biomimetic and evolutionary biology applications."
Proceedings of the National Academy of Sciences 117.30 (2020):17622-17626.

❑自身の研究の強み

・建築分野は人々の生活に不可欠であり、なじみ深く実現化のイメージがしやすい

・幾何学的な設計はスケールに捉われないため、様々な領域との横断が可能
（生物物理、機械工学、材料工学、宇宙工学 etc.）

・実寸大を対象としたモノづくり経験とコンピュータシミュレーションの知識

❑新たな学際的融合研究・社会貢献に結びつけるためには

・環境配慮の視点から、いかに少ない材料や資源から空間を構築することを目的としている
→ 脱炭素・省エネルギー社会を目指した構造や環境装置の実現と活用

多角的な視点から見た建築分野との
相互の応用可能性を探り、
具体的なモノとして社会実装を目指す

Deployable Architecture ✖ *Biomimetics Engineering*

応募者氏名 / Applicant Name	北島千朔 / Kitajima Chisaki