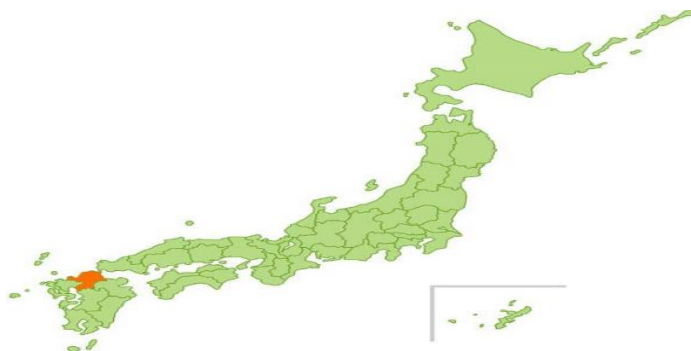


緑伝

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Food scrap as fertilizer and features of anaerobic digested liquid

食品残渣堆肥・消化液特徴について

About anaerobic digestion of food waste and food waste compost

食品残渣発酵消化液及び食品残渣堆肥について

Composting effectiveness and environmental impact

肥料効果と環境への影響

- ❖ Does not use animal or human manure.
- ❖ 動物性・人糞などは原料を使用しない
- ❖ Everything is made from plant based organic and animal feed material.
- ❖ 全て、植物性原料として有機肥料及び飼料用として製造
- ❖ Contains large amount of Euglena (Contains Vitamin, Mineral, fat, and many other nutrients. Much research of Euglena is being conducted for biofuel production, medical treatment, environmental improvement, and others.)
- ❖ ミドリ虫（ユーグレナ）多く含まれている
（ビタミン、ミネラル、脂肪など、十種類の栄養素は含まれている。ミドリムシを用いたバイオ燃料の製造、医療、環境改善などへの応用する研究が進んでいる
- ❖ As it contains large amounts of humus content, CEC (Cation Exchange Capacity) is larger and will hold fertilizer effect better. It will also act as cushion element, adding amino acid and the like which improves quality of the product. Flavour, colouring and sugar content will also improve.
- ❖ 腐植含有量が多いので、CEC（塩素置換容量）が大きい、肥持ちを良くします。また、緩衝要素、アミノ酸によって品質、味、色沢、糖度等を向上します。
- ❖ Increases good microorganisms in soil (bacteria, actinomycete and similar) which will protect it against soilborne pathogen.
- ❖ 土壌の有効微生物（細菌、放線菌など）の増殖に寄与し、土壌病害の発生を抑制します。
- ❖ Speeds up the process of soil aggregation, as well as improving water retention, water permeability and breathability.
- ❖ 土壌の団粒化を促進し、秀品多収お役に立ちます。

- ❖ Improves root growth, accelerates growth in crops in short, excellent product and high yield.
- ❖ 根張りが良く、作物の健全な生育を促進し、秀品多収にお役に立ちます。
- ❖ Compared to animal derived compost and fertilizer, it does not produce heavy foul odour.
- ❖ 動物性堆肥に比べて臭いも少ない



Figure 1 Euglena Gracilis, or commonly referred to as Euglena

Contents (in %) 原料使用割合 (%)

Food industry waste 15%

食品工業汚泥 15%

Vegetable matter (food processing residue) 65%

植物質原料（食品加工残渣） 65%

Vegetable matter (syrup or similar) 1%

植物質原料（シロップ等） 1%

Vegetable matter (Shochu distillation lees) 17%

植物性原料（焼酎粕等） 17%

Vegetable matter (soy milk or similar) 2%

植物性原料（豆乳等） 2%

Waste from production of tea, juice, tofu, coffee, Shochu (Japanese rice wine), soy milk, soy milk, rice, and beer (malt) as well as vegetable scrap, fruit scrap, seaweed, and bamboo material.

茶殻、ジュース絞り粕、豆腐粕、珈琲粕、焼酎粕、豆乳、米、ビール麦芽粕、野菜屑、果物屑、海藻、竹繊維等



Figure 2 Fertilizers made from food scraps

Component / Analysis items (成分)		
Nitrogen (N)窒素	4.36	%
Phosphoric acid (P)リン	2.89	%
Potassium (K) 加里	0.97	%
Carbon-nitrogen ratio (C/N) 炭素窒素比	7	
Moisture 水分	19.03	%
Hydrogen ion concentration (pH) 水素イオン濃度 (PH)	7.3	
Arsenic (砒素)	1.8	mg/kg
Cadmium (カドミウム)	Less than 0.5	mg/kg
Hydrogen (水銀)	0.06	mg/kg
Nickel (ニッケル)	55	mg/kg
Chromium (クロム)	33	mg/kg
Lead (鉛)	10	mg/kg
Available container size	20 Feat	

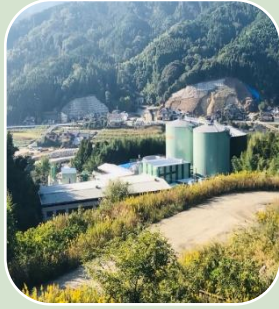
Fertilizer application method/ rate of application (per 10 Ares/1000 m²)

施肥方法及び施用量 (10 アール当たり)

Foliage(果実類)	600 - 750 kg
Leafy vegetables(葉菜類)	450 - 600 kg
Root foliage(根葉類)	300 - 450 kg
Flowers (花卉)	300 - 450 kg
Paddy rice (水稻)	225 - 300 kg
Fruit tree (果樹)	600 - 750 kg



Food scraps are processed in a fermenter



Energy for electricity and boiler



Food scrap powder



Food scrap anaerobic digested liquid

食品残渣発酵消化液の畑地における液肥利用

Food waste anaerobic digestion used in farmland as liquid fertiliser

Digestive fluids can be used as liquid fertilisers or disposed in bodies of water after being treated properly.

消化液は、排水処理を行った上で河川等に放流する場合と肥料成分が多く含まれる特長を活かし液肥として多く使われている。

	Fertiliser use (液肥利用)
Advantage (長所)	Can be used to reduce usage of other fertilizers as it includes such nutrients as nitrogen and potassium. 消化液に含まれる窒素、カリウム等の肥料成分を有効利用でき、他肥料使用料は削減できる。
Disadvantage (短所)	Requires large area of farmland to be dispersed properly. 散布するための十分な農地面積の確保が必要

Content of fertilizers made from anaerobic digested fluid

消化液の肥料成分

Due to the process of methane fermentation, most nutrients like nitrogen, phosphorus, and potassium used in fertilizers are turned into the digested liquid, reflecting on the composition of methane fermentation.

メタン発酵において、原料に含まれる肥料成分の窒素、リン、カリウムは、ほぼ全量が消化液に移行するため、その成分はメタン発酵の成分組成を反映します。



Analysis Result	
N (Total amount of nitrogen 窒素)	1.02%
P (Phosphoric acid) リン酸	0.27%
K (Potassium) 加里	0.26%
Carbon ratio (C/N) 炭素窒素比	2
Total amount of copper 銅	5.5 mg/kg
Total amount of zinc 亜鉛	18 mg/kg
Total amount of lime 石灰	0.20
Moisture 水分	94.53
Hydrogen ion concentration (PH)水素イオン濃度(PH)	8.4 (22°C)
Electrical conductivity (EC) 電気伝導率	4.48 mS/cm

希釈濃度

Dilution concentration

100 倍に希釈 Dilute 100 times

The effect of anaerobic digested fluid as a fertilizer and the environment

消化液の肥料効果と環境への影響

As a fertilizer used in agricultural farmland soil, nitrogen will be transformed to different things, absorbed by vegetations, dispersed into the air as gas (Vaporised) or moves deeper into the ground through moisture and eventually into underground water (image 2).

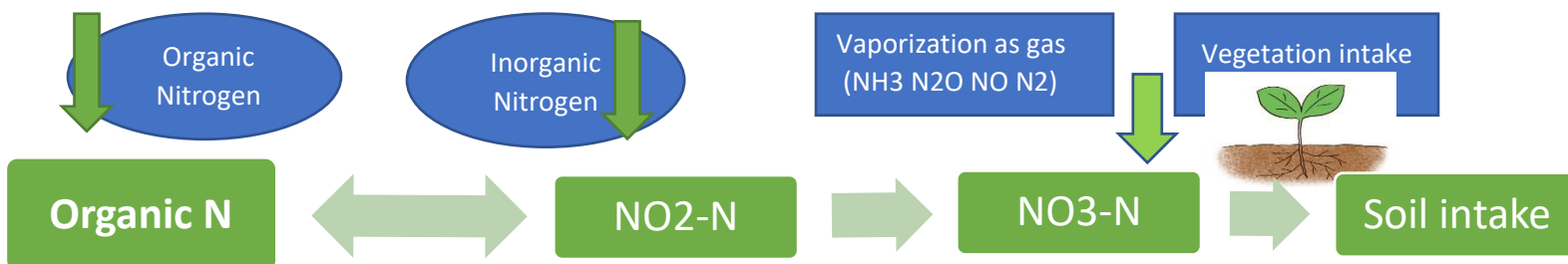
It is important that we understand the state of nitrogen and its movements to use anaerobic digested fluid effectively as a fertilizer, while protecting the environment.

肥料として農地土壌（畑地）に施用された窒素は、様々な形態変化を経て、作物に吸収されたり、気体となって大地に放出されたり（ガス揮散）、土壌中の水の下方移動によって地下水へと流出します（図2）

[Analysis Point for consideration] Effects of anaerobic digested liquid

【検討項目】 消化液の肥料効果に関する項目

- ❖ Anaerobically produced organic nitrogen – the level of anaerobic within the organic nitrogen content of digested liquid.
有機窒素の無気化量・・・液肥に含まれる有機態窒素のうち、どの程度か無機化するのか
- ❖ Possible amount uses of digested fluid - articles discussing the adequate amount to use and avoiding overflow, to prevent impact on the environment.
- ❖ 消化液の施用可能量・・・施用後に表面流出が生じない施用量はどの程度か消化液の施用に伴う環境に関する項目
- ❖ Leakage into deep underground – the adequate level for vegetation to absorb and not escape into underground water, causing environmental damage.
地下への窒素液脱量・・・作物に吸収されずに下方へ移動する割合はどの程度で、地下水質に及ぼす影響はどの程度か？



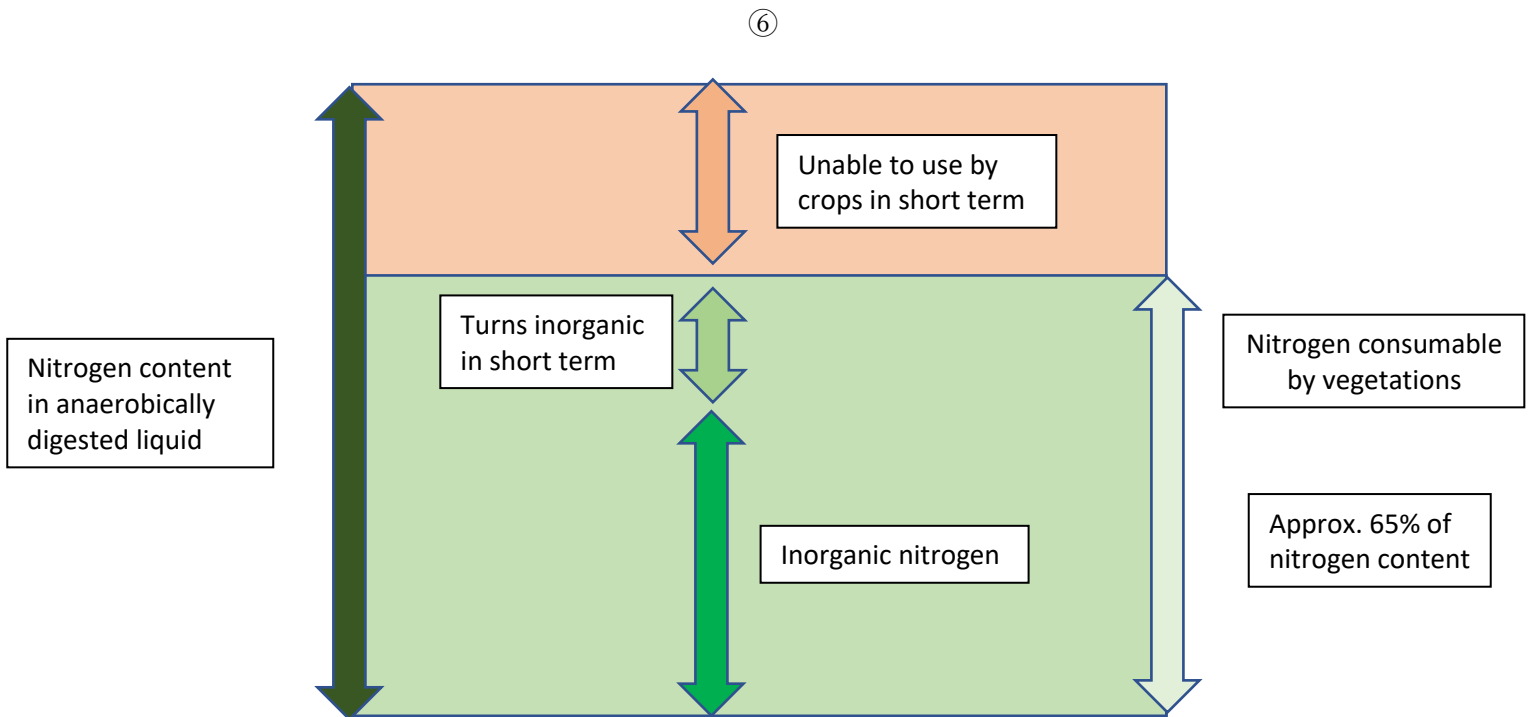
65% of the nitrogen contained in anaerobically digested liquid can be used as an accelerated nitrogen fertilizer.

消化液に含まれる窒素の 65%程度が速効性の窒素肥料として利用できる

Organic Nitrogen = 有機態窒素 Inorganic Nitrogen = 無機態窒素 Vaporization as gas = ガス揮散

Vegetation intake = 作物吸収

Soil intake = 土壌蓄積



Nitrogen Content in anaerobically digested liquid = 消化液に含まれる窒素

Unable to use by crops in short term = 短期的には無機化せず、作物に利用されない窒素

Turns inorganic in short term = 短期的に無機化する窒素

Inorganic nitrogen = 消化液にふくまれていた無機態窒素

Nitrogen consumable by vegetations = 短期的に作物が利用できる窒素量

Approx, 65% of nitrogen content = 消化液に含まれる窒素の 65%程度

⑦

More effectiveness compared to manure-based fertilizer

堆肥に比べて速効性が期待出来る

Food scraps (not including animal manure) is used as biomass material, adding water in while mixing the load is then sent to a vacuumed chamber to start the methane fermentation process. This lasts no more than 40 days in temperature of approximately 38 degrees Celsius.

食品残渣（動物性糞類などは含まない）バイオマス为原料として受入れ、加水しながらかき混ぜて、密閉の発酵槽に送り、最長で40日間にわたって38度前後の温度でメタン発酵を促進します。

As a result, methane gas is produced to power electricity and anaerobically digested liquid or food residue fertilizer. Compared to the preprocessing state of the biomass material, the nutrition contents such as nitrogen or phosphoric acid can be observed to not vary very much. Although the nitrogen will turn to organic nitrogen can be observed.

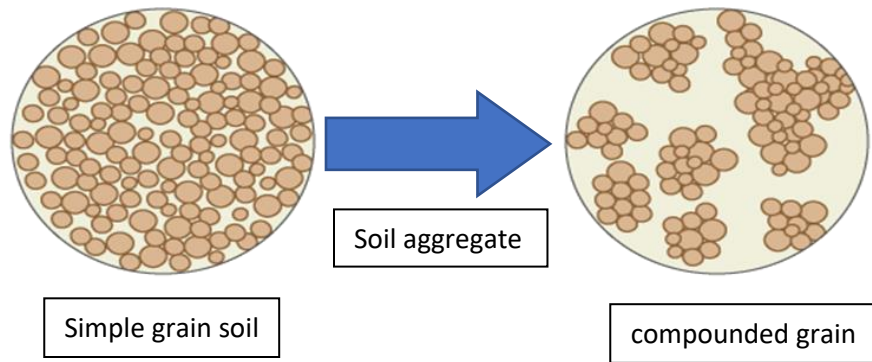
メタンガスを発生させて発電を行うと同時に「消化液及び食品残渣堆肥」を生産しますが、処理前の原料であるバイオマスと「消化液」の成分を比較すると、窒素やリン酸といった肥料成分の総量に変わりがなくとも、窒素成分の組成が「有機態窒素」に変化していることなどが確認されています。

When anaerobically digested fluid is used in a field, the microorganisms become more active and aggregating the soils around it, changing the formation of the soil. "A field that have used anaerobically digested fluid have aggregated soil and when held into hand, it is very fluffy and light. When it rains, there is visible improvement of water absorbing in the soil." (Kyushu University, Professor Yabe)

「消化液」を散布した畑では、微生物の活動が活性化することから、土壌では団粒構造の形成が促進される効果が期待でき、「消化液を長年散布してきた畑では、団粒化が進み、土を手にとると、空気を含んでフカフカになり、雨水時の畑の水はけも目に見えて改善します」

(国立九州大学名誉教授矢部教授)

⑧

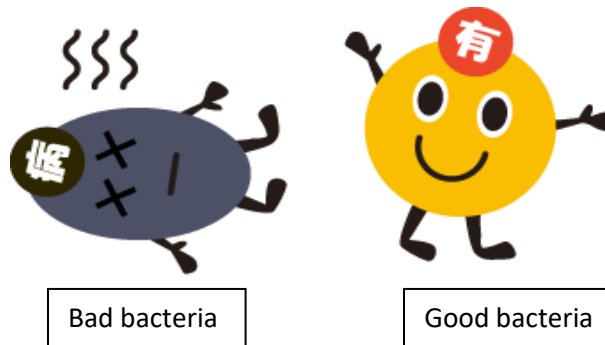


Simple grain soil = 単粒構造土 Soil aggregate = 団粒化 Compounded grain = 団粒構造の土




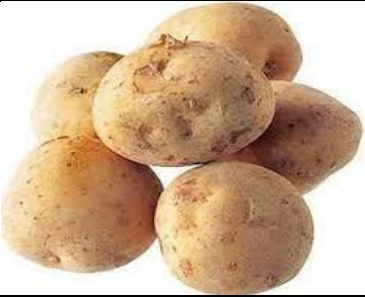


Increasing good bacteria and decreasing bad bacteria

In the process of production, colitis germ like salmonella is mostly killed off. It is also known that some crop disease control useful bacterium, bacillus, will survive the production process.

バイオマスに含まれる大腸菌、サルモネラといった病原菌は、「消化液に含まれる窒素約 65% は速効性成分として利用が出来る



Application examples (応用例)

Wheat grown (t/10a)		Beet (t/10a)	
	3.0		4.0
Wheat after sowing (t/10a)		Potato (t/10a)	
	2.6		4.0
Azuki (t/10a)		Corn (t/10a)	
	4.0		10.0



まとめ(Summary)

Effect of anaerobically digested liquid as a fertilizer and to the environment

消化液の肥料効果と環境への影響

- If the liquid is applied to soil right after the production procedure, nitrogen level of about 65% can be used as fast-acting property effectively.

消化液を施用後速やかに土壌と混和すれば、消化液に含まれている窒素の約65%は速効性成分として利用出来る

- Using anaerobic digested liquid in place of chemical fertilizers will have minimal environmental effect on underground water quality.

消化液で化学肥料を代替しても地下水へ影響は少ない

- ❖ Difference between food scrap anaerobically digested fluid and food wastage + livestock waste digested fluid

食品残渣消化液と食品廃棄物+家畜排泄物混合との違い

- When food wastage (livestock waste) mixture is scattered on to the farmland, the ammonia nitrogen in the liquid will vaporize into the air and will be useless to the soil or crops.

食品廃棄物（家畜排泄物）混合の消化液の消化液を農地土壌に表面施用すると、その直後に消化液中のアンモニア態窒素の一部が大気中に揮散し、施用した肥料成分が損失につながります。

Food scrap anaerobically digested fluid does not contain ammonia; therefore, it will be more effective to the field applied

食品残渣消化液に関してアンモニアが混入していないので、施用した肥料成分の損失につながらない。



200 ℓ



1,000 ℓ