Foods 2024 Conference
The 5th International Electronic Conference on Foods
28-30 October 2024| Online
MDPI

Nutritional properties of selected edible insects as food for future

Yee Ling Tan, Fuen Ann Tan, Fook Yee Chye*
Food Security Research Laboratory, Faculty of Food Science and Nutrition,
Universiti Malaysia Sabah, 88400 Kota Kinabalu, MALAYSIA.

INTRODUCTION & AIM

Current global Issues → Impact of food security

- Growing global population
- Shrinking agriculture land
- Climate change
- Rising carbon footprint
- War/conflict

- Hunger
- Health problems
- Malnutrition
- Stress

(Lin et al., 2023; Lange & Nakamura, 2021; FAO, 2018)

Current situation

World population projected to exceed **9 billion by 2050** and 10.4 billion by 2100 (United Nations, 2022).

1 in 11 people worldwide faced hunger in 2023

Food production must increase by 100% to feed the growing population

Advantages of using insects as food

Application
- protein powder
- insect flour
- snacks
- supplements
- meat alternative

Health benefits
- antioxidants activities
- anti-inflammatory
- antibacterial activities
- anti-diabetic
- anti-cancer
- anti-viral
- gastrointestinal health

Sustainable

(Weru et al., 2021; Zhou et al., 2022)

Nutritional benefits of Entomophagy

Factor affecting the nutritional content - insect species, diet, metamorphic stage, and environment

9.9 - 35.2 g/100g	**Protein**	16.8–20.6 g/100g
0.7 - 18.3 g/100g	**Fats**	4.4-24.9 g/100g
High	**Dietary Fiber**	Low

Mineral contents
High in Mg, Zn, Co, Fe

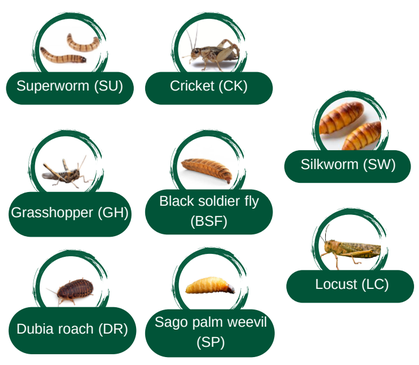
Vitamin contents
High in B1, B2, B6, C, D, E, K

(Zhou et al., 2022; Oonincx & Finke, 2020; de Castro et al., 2018)

Objectives

1. To determine the proximate composition of edible insects.
2. To evaluate the amino acid and fatty acid profile of edible insects.
3. To determine which insects could be a potential source of future food.

METHODS



Macronutrients analysis
1. Moisture content
2. Ash content
3. Crude protein content
4. Crude fat content
5. Total carbohydrate content

(AOAC, 2012)

Nutrient profile determination
1. Fatty acid profile - Dietary indicators (PUFA/SFA, n-6:n-3, IA, IT, h/H HPI)
2. Amino acid profile

(Wang et al., 2015; Kavle et al., 2023)

RESULTS & DISCUSSION

Macronutrient analysis

Nutrient content (g/100g)	Studied species							
	SP	BSF	CK	DR	GH	LC	SW	SU
Moisture	4.52±0.32^{c}	5.55±0.06^{c}	3.46±0.03^{d}	3.03±0.16^{ef}	6.37±0.10^{b}	6.52±0.32^{b}	2.84±0.04^{f}	11.20±0.06^{a}
Crude fat	52.27±0.19^{a}	27.6±0.04^{c}	20.36±0.42^{e}	27.70±0.09^{c}	5.54±0.23^{f}	5.54±0.21^{f}	23.77±0.59^{d}	35.87±0.51^{b}
Crude protein	29.47±0.21^{g}	39.35±0.11^{f}	46.54±0.08^{e}	47.90±0.31^{d}	68.18±0.45^{a}	66.45±0.22^{b}	58.41±0.13^{c}	39.09±0.34^{f}
Carbohydrate	8.76±0.64^{e}	23.56±0.60^{b}	27.13±0.58^{a}	16.63±0.70^{c}	16.28±0.16^{c}	17.76±0.78^{c}	10.63±0.86^{d}	10.29±0.34^{de}
Ash	5.38±0.15^{a}	5.19±0.43^{a}	3.46±0.03^{b}	5.25±0.63^{a}	4.65±0.23^{a}	4.88±0.20^{a}	4.65±0.72^{a}	4.70±0.67^{a}
Energy (kcal/100g)	637.27±0.85^{a}	551.09±6.56^{b}	483.94±1.91^{e}	512.53±2.70^{c}	394.03±1.45^{f}	393.10±1.36^{f}	495.58±5.03^{d}	290.58±4.20^{g}

32.6g/100g	20.1g/100g	27g/100g	16.9g/100g
247kcal/100g	112kcal/100g	125kcal/100g	13.2kcal/100g

GH, LC & **SW** → higher protein content & energy content

Fatty acid content

- **Fatty acids identified:** Linoleic, alpha-linolenic, palmitoleic, oleic, capric, lauric, myristic, pentadecanoic, palmitic, heptadecanoic, stearic, and arachidic acids
- **Oleic acid** is present in all insects, helping lower blood pressure and reduce CVD risk
- **BSF** is high in **lauric acid,** comparable to palm kernel and coconut fat
- **LC & GH** are rich in **PUFAs,** offering an alternative to fish oils
- Over 50% of fatty acids of **SP** are **MUFAs** (oleic acid)

(Ewald et al., 2020; Hirunyophat et al., 2020)

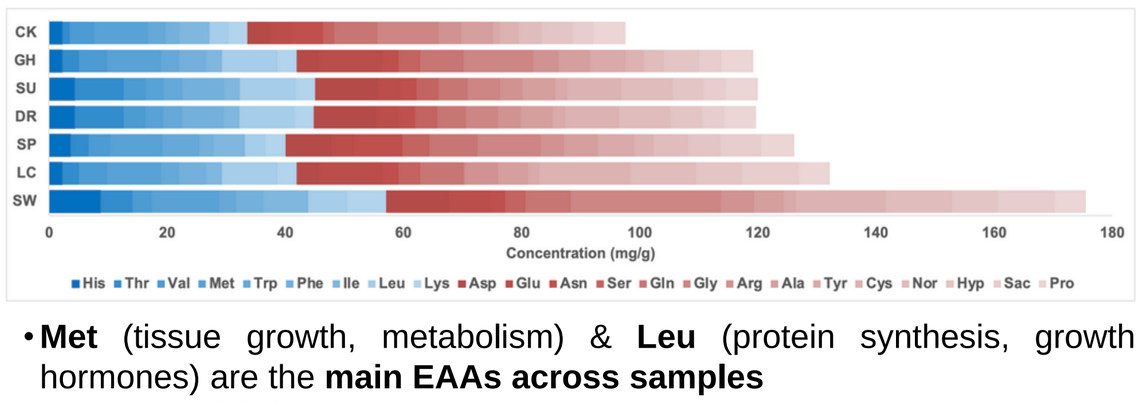
Fatty acid indices as indicator for hypocholesterolemic properties

Nutritional indices	Std	Studied species							
		SP	BSF	CK	DR	GH	LC	SW	SU
PUFA/SFA ratio	≈ 1	0.18±0.00^{h}	0.55±0.00^{e}	0.81±0.00^{d}	0.27±0.00^{g}	0.87±0.00^{a}	0.85±0.00^{b}	0.82±0.00^{c}	0.47±0.00^{f}
Omega 6: Omega 3 ratio	< 10	1.53±0.00^{c}	9.32±0.02^{b}	–	–	0.58±0.00^{cd}	0.60±0.00^{cd}	0.62±0.00^{cd}	23.27±0.11^{a}
Health-promoting index (HPI)	-	1.72±0.01^{d}	1.03±0.98^{e}	4.93±0.01^{dc}	1.16±1.42^{d}	5.77±0.08^{b}	6.07±0.04^{b}	8.38±0.19^{a}	2.07±0.05^{d}
Index of atherogenicity (IA)	-	0.58±0.00^{fb}	2.95±0.01^{a}	0.20±0.00^{d}	0.46±0.00^{c}	0.18±0.01^{de}	0.17±0.01^{e}	0.12±0.00^{f}	0.49±0.01^{c}
Index of thrombogenicity (IT)	-	1.82±0.02^{ef}	1.56±0.01^{f}	2.80±2.06^{d}	0.98±0.01^{g}	13.6±0.14^{b}	14.1±0.04^{a}	1.31±0.93^{c}	1.92±0.21^{e}
Hypocholesterolemic/ hypercholesterolemic ratio (h/H)	-	1.67±0.01^{e}	0.44±0.00^{f}	4.93±0.01^{c}	2.21±0.01^{d}	7.12±0.05^{b}	7.27±0.04^{b}	8.38±0.19^{a}	2.29±0.06^{d}

- **↓IA, ↓IT, ↑h/H ratio = lower risk of CVD**
- **GH**, **LC** & **SW** had the best **PUFA/SFA** ratios (0.87, 0.85, 0.82)
- All samples had **higher HPI than dairy**
- **IA & IT** are comparable to meat/fish, but lower than dairy
- **SW** had the **best lipid profile**: ↓IA (0.12), ↓IT (1.31), ↑h/H (8.38).
- **Variability in indices** due to **lipid extraction methods** & **diet**.

(Chen & Liu, 2020; Ewald et al. 2020)

Amino acid content



- **Met** (tissue growth, metabolism) & **Leu** (protein synthesis, growth hormones) are the **main EAAs across samples**
- **GH** & **DR: rich in Leu** (9.44 mg/g, 9.37 mg/g)
- **SW & DR: higher Gly**, **Asp** & **Glu** → **rich, meaty flavour**
- **SW** has the best amino acid ratio (E/T %) - 57.52%

CONCLUSIONS

- **GH**, **LC** and **SW** could be excellent sources of alternative proteins
- **LC** could be potentially a healthy food for future

FUTURE WORK / REFERENCES

1. Evaluate the safety and allergenicity of selected insects
2. Functional properties of products made from insects
3. Innovative products from insects and their acceptance

List of references