BOTANICAL ORIGIN, NUTRITIONAL VALUES AND PROBIOTIC PROPERTIES OF BEE BREAD OF STINGLESS BEE (Heterotrigona itama Cockerell)

SALMA MALIHAH BINTI MOHAMMAD

FSTM 2020 16

BOTANICAL ORIGIN, NUTRITIONAL VALUES AND PROBIOTIC PROPERTIES OF BEE BREAD OF STINGLESS BEE (*Heterotrigona itama Cockerell*)

By

SALMA MALIHAH BINTI MOHAMMAD

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

May 2020

Dedication to those who has painted the dark universe with beautiful lights

And to those who seeks knowledge in between pages

“Handle a book as a bee does a flower, extract its sweetness but do not damage it.”

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

BOTANICAL ORIGIN, NUTRITIONAL VALUES AND PROBIOTIC PROPERTIES OF BEE BREAD OF STINGLESS BEE (*Heterotrigona itama Cockerell*)

By

SALMA MALIHAH BINTI MOHAMMAD

May 2020

Chair : Norhasnida Binti Zawawi, PhD
Faculty : Food Science and Technology

Bee bread is bee-collected pollen, added with honey and bee salivary enzymes. It undergoes lactic acid fermentation by indigenous microbes as it is stored inside the closed pots in the beehive. In comparison to honey, bee bread is still an underutilized bee product with limited nutrient information. This study aims to identify the botanical origin and characterize the nutritional composition of stingless bee (*Heterotrigona itama*) bee bread and also isolate and further characterize the probiotic potential of bacteria from the bee bread. The melissopalynology analysis using a Scanning Electron Microscope (SEM) discovered *Biden pilosa* in bee bread samples from all geographical locations with *Asteraceae* as the predominant family plant. From the proximate analysis, *H. itama* bee bread was found to be high in carbohydrate (58.03 ± 0.75%), protein (22.46 ± 0.63%), lipid (5.29 ± 0.53%) and ash (2.56 ± 0.13%). The sugar profile analysis using High-Performance Liquid Chromatography- Evaporating Light Scattering Detector (HPLC-ELSD) found glucose as the most abundant followed by fructose. The amino acids were quantified with HPLC-Fluorescence Detector (FLD). Eight essential amino acids were present with phenylalanine as the most abundant with 2.317 g/100 g. The mineral content and heavy metals were analyzed using Inductively Coupled Plasma Mass Spectrometry (ICP-MS). The major mineral element was potassium (average 6705.9 mg/kg). Heavy metals such as lead, arsenic, cadmium and mercury were detected within the safe permitted levels. Ninety-seven (97) bacterial strains were isolated from *H. itama* bee bread. From these, 27 were presumed to be lactic acid bacteria (LAB) and *Bacillus* from Gram-staining and catalase test. The presumptive bacteria were identified using 16s rRNA gene sequencing. These bacteria were *Lactobacillus musae, Lb. crustorum*, *Lb. mindensis*, *Leuconostoc mesenteroides*, *Enterococcus faecalis, Fructobacillus fructosus*, *Bacillus safensis, B. amyloliquefaciens, B. megaterium*, *B. cereus* and *B. pumilus*. The bacteria were evaluated for its hemolytic ability on 5% blood sheep agar. All LAB

strains and *B. megaterium* MPS2 did not hemolyzed blood. Antagonistic activities against foodborne pathogens using agar well diffusion showed *L. musae* SGMT17 and *L. crustorum* SGMT22 with the highest inhibition zone, comparable to those of commercial strains *Lb. rhamnosus* GG. The bacteria with antibacterial properties were assessed for their viability in pH 3, 0.3% bile and digestive enzymes. All strains were able to tolerate the simulated conditions except for *F. fructosus* U45 and U47 as they recorded viability below 80% after treatment in pepsin and pancreatin simultaneously. The adhesion properties using autoaggregation and cell surface hydrophobicity (CSH) demonstrated *L. mindensis* SGMT22 with highest autoaggregation ability (41.16%) while *Lc. mesenteroides* U39 showed the highest CSH (80.52%). The antibiotic resistance patterns for the isolates against 11 antibiotics were assessed using the disc diffusion method and interpreted using standard of Clinical and Laboratory Standard Institute (CLSI). All strains were susceptible to chloramphenicol, ampicillin and tetracycline, but varied for eight antibiotics. From the result obtained, *Lb. musae* SGMT17 and *Lb. crustorum* SGMT20 showed the highest antibacterial activity and probiotic properties in the human *in vitro* digestive model. The outcomes of this study contribute towards the knowledge on the nutritional information of *H. itama* bee bread, its potential as commercialize food or food ingredients.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

ASAL USUL BOTANI, NILAI NUTRISI DAN CIRI-CIRI PROBIOTIK DALAM ROTI LEBAH KELULUT (*Heterotrigona itama Cockerell*)

Oleh

SALMA MALIHAH BINTI MOHAMMAD

Mei 2020

Pengerusi : Norhasnida Binti Zawawi, PhD
Fakulti : Sains dan Teknologi Makanan

Roti lebah adalah debunga yang dikumpul lebah, ditambah dengan madu dan air liur lebah sebelum disimpan di dalam sarang di mana ia menjalani proses penapaian oleh mikrob. Berbanding dengan madu, roti lebah merupakan produk kelulut yang kurang dimanfaatkan berikutan kekurangan maklumat mengenai nutrisinya. Kajian ini bertujuan untuk mengenalpasti asal usul pokok dan komposisi nutrisi roti lebah kelulut *Hetrotrigona itama* dan selanjutnya mengisolasi dan mencirikan potensi probiotik bakteria yang diperoleh dari roti lebah. Analisis melissopalynogi menggunakan mikroskop imbasan electron (SEM) menunjukkan terdapat debunga dari pokok *Biden polisa* dalam sampel roti lebah dari setiap kawasan. Pokok dari keluarga *Astaracea* merupakan yang utama. Dari analisis proksimat, roti lebah *H. itama* mempunyai karbohidrat yang tinggi (58.03 ± 0.75%), protein (22.46 ± 0.63%), lemak (5.29 ± 0.53%) dan abu (2.56 ± 0.13%). Analisis gula menggunakan kromatografi cecair berprestasi tinggi yang dilengkapi dengan pengesan pengewapan serakan cahaya (HPLC-ELSD) mendapati glukosa sebagai gula yang paling banyak dan diikuti oleh fruktosa. Asid amino dikuantifikasi menggunakan kromatografi cecair berprestasi tinggi yang dilengkapi dengan pengesan pengewapan serakan cahaya (HPLC-FLD). Terdapat lapan asid amino penting, dimana phenylalanin merupakan tertinggi dengan nilai 2.317 g / 100 g. Kandungan mineral dan logam berat dianalisa menggunakan pasangan plasma induktif-mass spektroskopi (ICP-MS). Unsur mineral utama di dalam roti lebah ialah kalium (purata 6705.9 mg / kg). Logam berat seperti plumbum, arsenik, kadmium dan merkuri turut dikesan, tetapi dalam tahap yang selamat. Sembilan puluh tujuh (97) bakteria telah diasingkan dari roti lebah *H. itama*. Daripada jumlah ini, 27 diramalkan sebagai bakteria asid laktik (LAB) dan Bacillus setelah dilakukan pewarnaan Gram dan ujian katales. Bakteria telah dikenal pasti menggunakan penjujukan gen rRNA 16s. Bakteria ini ialah *Lactobacillus musae, Lb. crustorum, Lb mindensis, Leuconostoc mesenteroides, Enterococcus faecalis, Fructobacillus fructosus, Bacillus safensis, B. amyloliquefaciens, B. megaterium, B. cereus* dan *B. pumilus*. Bakteria dinilai untuk keupayaan hemolitik pada agar yang

dicampur 5% darah kambing biri-biri. Semua strain LAB dan *B. megaterium* MPS2 tidak menghemolisis darah. Aktiviti antagonistik terhadap patogen bawaan makanan menggunakan penyebaran agar menunjukkan *L. musae* SGMT17 dan *L. crustorum* SGMT22 dengan kawasan inhibisi tertinggi, setanding dengan strain komersil *Lb. rhamnosus* GG. Bakteria dengan sifat antibakteria dinilai untuk keupayaan untuk dalam kondisi pH 3, 0.3% hempedu dan enzim secara asing. Semua strain mampu hidup dalam keadaan simulasi kecuali *F. fructosus* U45 dan *F. fructosus* U47 kerana mereka mencatatkan keupayaan hidup di bawah 80% selepas rawatan di dalam pepsin dan pancreatin secara serentak. Ciri-ciri adhesi menggunakan autoaggreasi dan hydrofobisiti permukaan sel (CSH) menunjukkan *L. mindensis* SGMT22 dengan keupayaan autoaggregasi tertinggi (41.16%) manakala *Lc. mesenteroides* U39 menunjukkan CSH tertinggi (80.52%). Corak rintangan antibiotik untuk isolat terhadap 11 antibiotik telah dinilai menggunakan kaedah penyebaran cakera dan ditafsirkan menggunakan piawaian dari institut standard klinikal dan makmal (CLSI). Semua strain sensitif kepada chloramphenicol, ampicillin dan tetracycline, tetapi berbeza bagi lapan antibiotik lain. Dari hasil yang diperolehi, *Lb. musae* SGMT17 dan *Lb. crustorum* SGMT20 menunjukkan aktiviti antibakteria tertinggi dan sifat probiotik dalam model pencernaan *in vitro* manusia. Hasil kajian ini menyumbang kepada pengetahuan mengenai maklumat nutrisi pemakanan roti lebah *H. itama*, berpotensi untuk dikembangkan sebagai produk komersil atau bahan makanan. Lebih banyak kajian perlu dilakukan pada bakteria yang dipilih untuk mengenalpasti nilai terapeutik lain dan keselamatannya menggunakan model *in vivo*

ACKNOWLEDGEMENTS

In the name of Allah, the Most Gracious the Most Merciful. All praise to Him for allowing me to take and complete this journey with my best condition and ability.

I would like to express my sincere appreciation to my supervisor, Dr Norhasnida Zawawi and co-supervisor, Dr Nor-Khaizura Mahmud-Ab-Rashid, who have constantly guided, monitored, encouraged me and provide constructive criticisms and feedbacks throughout my research studies. Thank you for your time, caring and understanding. Without these, this research project may have not achieved its goal.

I also would like to recognize the invaluable assistance and resource provision of the laboratory staff and technicians at Laboratory of Molecular Biomedicine Institute Bioscience (IBS), Microscopy Unit IBS, and Laboratory of Functional Food, FSTM. Acknowledgement also goes to Universiti Putra Malaysia (UPM) for providing me financial support under Graduate Research Fellowship (GRF) and providing grant under Putra Grant Scheme.

I wish to show my gratitude towards my family for their love, support and understanding. I am thankful to my fellow lab mate, Fatin Aina for her friendship and support during my study. For my dearest friends, Shaidatul Lyana, Inani and Hasliza, I am grateful for your presence, patience and continuous support during my highest and lowest point at UPM.

Special thanks to those who has, indirectly, reminding myself to be self-grounded and have self-love during my hardships in completing this study

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Science. The members of the Supervisory Committee were as follows:

Norhasnida binti Zawawi, PhD
Senior Lecturer
Faculty of Food Science and Technology
Universiti Putra Malaysia
(Chairman)

Nor-Khaizura binti Mahmud-Ab-Rashid, PhD
Associate Professor
Faculty of Food Science and Technology
Universiti Putra Malaysia
(Member)

_____
ZALILAH MOHD SHARIFF, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

Declaration by graduate student

I hereby confirm that:

- this thesis is my original work;
- quotations, illustrations and citations have been duly referenced;
- this thesis has not been submitted previously or concurrently for any other degree at any other institutions;
- intellectual property from the thesis and copyright of thesis are fully-owned by Universiti Putra Malaysia, as according to the Universiti Putra Malaysia (Research) Rules 2012;
- written permission must be obtained from supervisor and the office of Deputy Vice-Chancellor (Research and Innovation) before thesis is published (in the form of written, printed or in electronic form) including books, journals, modules, proceedings, popular writings, seminar papers, manuscripts, posters, reports, lecture notes, learning modules or any other materials as stated in the Universiti Putra Malaysia (Research) Rules 2012;
- there is no plagiarism or data falsification/fabrication in the thesis, and scholarly integrity is upheld as according to the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) and the Universiti Putra Malaysia (Research) Rules 2012. The thesis has undergone plagiarism detection software.

Signature: _____ Date: _____

Name and Matric No.: Salma Malihah binti Mohammad (GS50933)

Declaration by Members of Supervisory Committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) are adhered to.

Signature: _____

Name of Chairman of Supervisory Committee: Dr. Norhasnida binti Zawawi

Signature: _____

Name of Member of Supervisory Committee: Associate Professor Dr. Nor-Khaizura binti Mahmud-Ab-Rashid

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

^{o}C	Degree Celsius
µL	Micro liter
µM	Micro molar
BLAST	Basic local alignment search tool
CLSI	Clinical and Laboratory Standard Institute
bp	Base pair
CO2	Carbon dioxide
CSH	Cell surface hydrophobicity
DNA	Deoxyribonucleic acid
DRI	Dietary reference intake
dNTP	2"-deoxy-nucleotide-5"-trphosphate
EDTA	Ethylene diamine tetra acetic acid
ELSD	Evaporating light scattering detector
FAO	Food and agriculture organization
FLD	Fluorescence detector
g	Gram
GIT	Gastrointestinal tract
H_2O_2	Hydrogen peroxide
HCL	Hydrochloric acid
HPLC	High-performance liquid chromatography
ICP-MS	Inductive coupled plasma mass spectroscopy
Kb	Kilo base pair
Kg	Kilogram
LAB	Lactic acid bacteria
M	Molar
MEGA 4	Molecular evolutionary genetics analysis version 4
MgCl2	Magnesium chloride
Min	Minute
ml	Milliliter
mM	Milimolar
MRS	De man, rogosa and sharpe
NaOH	Sodium hydroxide
NCBI	National center of biotechnology information
SEM	Scanning electron microscopy

CHAPTER 1

INTRODUCTION

1.1 Research Background

Bee products are crucial for bee survivals and it is believed to be acquired and used by human since 8000 BC as medicine, offering, cosmetic and everyday uses (Mizrahi & Lensky, 2013). Gradually, it influences the emergence of beekeeping industry whereby beekeepers collect these products for commercial purposes or personal uses. Malaysia beekeeping industry plays an important role in the agricultural area; for socioeconomic development and biodiversity conservation. Its contribution towards Malaysia regional growth depends on efficient production and marketing of bee products and bee byproducts (Ismail, 2014). Although this industry is progressively expanding in Malaysia, research on Malaysia bee byproducts are disregarded (Ismail, 2016), especially on stingless bee (locally known as '*kelulut*') species *Heterotrigona itama*.

Bee bread is one the bee byproducts, made from pollen collected by bee, added with nectar and bee salivary enzymes before undergoes lactic acid fermentation in beehives (Kieliszek et al., 2018). It is an underutilized bee product, mostly overshadowed by honey well-known status as the money maker (Ismail, 2016). The local market price for raw unprocessed wet bee bread is ranged from RM150-RM400/kg. Bee bread has brought newfound interest among Malaysian consumers largely because of the many claims on its health benefits. Demand for bee bread is expected to rise due to its nutritional value and application in apitherapy (Kieliszek et al., 2018). The Malaysian beekeepers are seizing this opportunity for generating incomes (Lob et al., 2017).

Bee bread is high in carbohydrate (24-34%), protein (14-37%), lipids (6-13%) and contain other macronutrients such as minerals, vitamin (Kieliszek et al., 2018), phenolic compounds (Vit, Albore, et al., 2018) and essential amino acids which can't be synthesized by human (Bonvehı & Escola, 1997; da Silva et al., 2014; Human & Nicolson, 2006). However, the chemical composition of bee bread is varied depending on the botanical origin, geographical location, climatic condition, soil type, beekeepers activities or storage treatments in the commercial production (Ares et al., 2018; Pascoal et al., 2014). The current report on Malaysian bee bread nutritional value is limited. So far, (Ismail et al., 2018) only reported on the nutrient analysis for *H. itama* bee bread from Perak. More information is needed to confirm bee bread nutritional values across other Malaysia region. Because bee pollen is rich in nutrient, it becomes a source for the microb ial growth in bee pollen. These microbes have a mutual relationship with bee. For the bee, microbes are essential to protect bee colonies against pathogens and to provide nutrient for bee growth (Engel et al., 2012). They also contribute towards bee pollen conversion into bee bread. Bee bread is

suggested to be preserved by lactic acid bacteria (LAB) which have been previously discovered in bee bread and bee pollen of honeybee *Apis mellifera* (Anderson et al., 2014; Vásquez & Olofsson, 2015). Apart from LAB, *Bacillus* species also attain it niche in bee bread of *Apis mellifera* and stingless bee *H. itama* products (Gilliam, 1979; Ngalimat, Raja Abd. Rahman, Yusof, Syahir, & Sabri, 2019). However, little is known on the probiotic potential of bacteria that facilitated the fermentation of bee pollen in stingless bee especially in the *H. itama* species.

Probiotic is "live microorganism", when administered in adequate amounts, gives health benefits to host (Araya et al., 2002). Lactic acid bacteria (LAB) such as *Lactobacillus*, *Streptococcus*, *Leuconostoc, Lactococcus* etc are the most prominent bacteria in the probiotic industry. However, other bacterial genera such as *Bacillus* have also shown promising outcomes as probiotic candidates (Elshaghabee et al., 2017). The general requirement for probiotic is to survive the gastrointestinal tract and safe for human consumption. Probiotic has been associated with functional foods because of the positive effect on gut microbiota (Ziemer & Gibson, 1998). Probiotic effect on host health is strain specific. Thus, the discovery of novel strains is desirable to improve the bio-therapeutic actions of probiotic bacteria incorporated in food and pharmaceutical products (Manap, 2008). Since certain bacteria species preferred different niche, exploring new source to isolate probiotic is to look-for. For this reason, this study also interested to investigate on the probiotic potential of bacteria isolated from bee bread.

1.2 Problem Statement

Although stingless bee *H. itama* is the dominant stingless bee species in Malaysia, the information on its by-products especially bee bread are still scarce and underexplored (Ismail, 2016). Current literature profoundly emphasized on honey from honeybee species (*Apis* spp.). This lack of information for Malaysia bee bread has led to a setback for its commercialization. Therefore, beekeepers loss the opportunities to generate additional profits from bee bread without heavily relying on honey as a source of incomes.

Reports have been disseminated on bee bread nutritional values, but these data largely depend on various factors such as botanical origin, geographical location, bee species, beekeepers activities and downstream processing (Ares et al., 2018; Pascoal et al., 2014). The beekeeping industry in Malaysia is flourishing. Unfortunately, beekeepers have not well equipped with scientific evidence to prove Malaysia bee bread nutritional value of its own. The nutritional claims exerted on local's bee bread mostly based upon studies from other countries which could mislead the consumers. With these lacks of data for Malaysia bee bread, the exact nutritional values are questionable leading to a lack of standardization for bee products. In addition, abundant literature has been reported on bacterial communities in bee bread but their probiotic potential remains unknown. The common public misconception upon probiotic relies upon the ideology that all probiotics work the same. Probiotic work in a

strain-dependent manner, therefore current studies which have documented on probiotic properties and health benefits cannot be extrapolated to other strains. Novel probiotic strains required extensive studies, on the basic level, is to characterize its viability in digestive tract and safety using *in vitro* studies. If not, the probiotic strains could not exert its benefits and could endanger the host well-being.

1.3 Objectives

This study was carried out to fulfil the following objectives;

1. To determine the botanical origin and characterize the nutritional composition of bee bread of stingless bee (*Heterotrigona itama*).
2. To isolate and identify lactic acid bacteria and *Bacillus* spp. from bee bread of stingless bee (*H. itama*).
3. To determine the probiotic properties of bacteria isolated from bee bread of stingless bee (*H. itama*) using *in vitro* tests.

1.4 Significance of study

This study will contribute toward the existing knowledge of bee bread of stingless bee (*Heterotrigona itama*) nutritional values in Malaysia. These data will provide valuable information to the Department of Standards Malaysia to establish the quality standard for bee bread. In line with the Ministry of Agriculture Malaysia's plan to promote the beekeeping industry, the outcome of this study will benefit the beekeepers to make profits from bee bread. Beekeepers will be more encouraged to develop bee bread into a commercialized product. The obtained information could also be used to promote the incorporation of bee bread as an ingredient for functional food development in local food. With the promising outcomes on bee bread nutritional values – yet limited, this could encourage other researchers to study bee bread from other Malaysia regions, especially in Borneo. The findings also provide insights towards bee bread as a potential source to isolate novel probiotics.

REFERENCES

Abouda, Z., Zerdani, I., Kalalou, I., Faid, M., & Ahami, M. T. (2011). The antibacterial activity of Moroccan bee bread and bee-pollen (fresh and dried) against pathogenic bacteria. *Research Journal of Microbiology*, *6*(4), 376. https://doi.org/10.3923/jm.2011.376.384

Abriouel, H., Franz, C. M. A. P., Omar, N. Ben, & Galvez, A. (2011). Diversity and applications of *Bacillus* bacteriocins. *FEMS Microbiology Reviews*, *35*(1), 201–232. https://doi.org/10.1111/j.1574-6976.2010.00244.x

Abushelaibi, A., Al-mahadin, S., El-tarabily, K., & Shah, N. P. (2017). Characterization of potential probiotic lactic acid bacteria isolated from camel milk. *LWT - Food Science and Technology*, *79*(2017), 316–325. https://doi.org/10.1016/j.lwt.2017.01.041

Adams, M. R., Moss, M. O., & McClure, P. (2016). *Food Microbiology* (4th Ed). The Royal Society of Chemistry.

Akcan, N. (2011). High level production of extracellular α -amylase from *Bacillus licheniformis* ATCC 12759 in submerged fermentation. *Romanian Biotechnological Letters*, *16*(6), 6833–6840. https://acikerisim.siirt.edu.tr/xmlui/handle/20.500.12604/2043

Akhir, R. A. M., Bakar, M. F. A., & Sanusi, S. B. (2017). Antioxidant and antimicrobial activity of stingless bee bread and propolis extracts. *AIP Conference Proceedings*, *1891*. https://doi.org/10.1063/1.5005423

Aldgini, H. M. M., Abdullah Al-Abbadi, A., Abu-Nameh, E. S. M., & Alghazeer, R. O. (2019). Determination of metals as bio indicators in some selected bee pollen samples from Jordan. *Saudi Journal of Biological Sciences*, *26*(7), 1418–1422. https://doi.org/10.1016/j.sjbs.2019.03.005

Almeida-Muradian, L. B., Pamplona, L. C., Coimbra, S., & Barth, O. M. (2005). Chemical composition and botanical evaluation of dried bee pollen pellets. *Journal of Food Composition and Analysis*, *18*(1), 105–111. https://doi.org/10.1016/j.jfca.2003.10.008

Altunatmaz, S. S., Tarhan, D., Aksu, F., Barutçu, U. B., & Or, M. E. (2017). Mineral element and heavy metal (Cadmium, lead and arsenic) levels of bee pollen in Turkey. *Food Science and Technology*, *37*, 136–141. https://doi.org/10.1590/1678-457X.36016

Alvarez-Cisneros, Y. M., & Ponce-alquicira, E. (2008). Antibiotic resistance of lactic acid bacteria. In *Antimicrobial resistance - A Global Threat* (Issue 482, pp. 725–729). IntechOpen limited. https://doi.org/10.2298/vetgl0806329b

Alves, R. M. de O., Sodre, G. da S., & Carvalho, C. A. L. (2018). Chemical, microbiological and palynological composition of the “Sambura” *Melipona scutellaris* pot pollen. In *Pot-Pollen in Stingless Bee Melittology* (pp. 349–360). https://doi.org/10.1007/978-3-319-61839-5

Ambika Manirajan, B., Ratering, S., Rusch, V., Schwiertz, A., Geissler-Plaum, R., Cardinale, M., & Schnell, S. (2016). Bacterial microbiota associated with flower pollen is influenced by pollination type, and shows a high degree of diversity and species-specificity. *Environmental Microbiology*, *18*(12), 5161–5174. https://doi.org/10.1111/1462-2920.13524

Amenu, D. (2015). Probiotic properties of lactic acid bacteria from human milk. *Journal of Medical Microbiology & Diagnosis*, *17*(8), 597–609. https://doi.org/10.4172/2161-0703.S3-005

Anđelković, B., Jevtić, G., Mladenović, M., Marković, J., Petrović, M., & Nedić, N. (2012). Quality of pollen and honey bee bread collected in spring. *Journal of Hygienic Engineering and Design*, *1*, 275–277.

Anderson, K. E., Carroll, M. J., Sheehan, T., Mott, B. M., Maes, P., & Corby-Harris, V. (2014). Hive-stored pollen of honey bees: Many lines of evidence are consistent with pollen preservation, not nutrient conversion. *Molecular Ecology*, *23*(23), 5904–5917. https://doi.org/10.1111/mec.12966

Anderson, K. E., Sheehan, T. H., Mott, B. M., Maes, P., Snyder, L., Schwan, M. R., Walton, A., Jones, B. M., & Corby-harris, V. (2013). Microbial ecology of the hive and pollination landscape : Bacterial associates from floral nectar , the alimentary tract and stored food of honey bees (*Apis mellifera*). *PloS One*, *8*(12), 1–16. https://doi.org/10.1371/journal.pone.0083125

Andrada, A. C., & Telleria, M. C. (2005). Pollen collected by honey bees (*Apis mellifera* L .) from south of Caldén district (Argentina): Botanical origin and protein content. *Grana*, *44*(2), 37–41. https://doi.org/10.1080/00173130510010459

Angmo, K., Kumari, A., & Bhalla, T. C. (2016). Probiotic characterization of lactic acid bacteria isolated from fermented foods and beverage of *Ladakh*. *LWT - Food Science and Technology*, *66*(March 2016), 428–435. https://doi.org/10.1016/j.lwt.2015.10.057

Aqeel, B. M., & Umar, D. M. (2010). Effect of alternative carbon and nitrogen sources on production of alpha-amylase by *Bacillus megaterium*. *World Applied Sciences Journal*, *8*, 85–90.

Arakawa, K., Yoshida, S., Aikawa, H., Hano, C., Bolormaa, T., Burenjargal, S., & Miyamoto, T. (2016). Production of a bacteriocin-like inhibitory substance by *Leuconostoc mesenteroides* subsp. *dextranicum* 213M0 isolated from Mongolian fermented mare milk, airag. *Animal Science Journal*, *87*(3), 449–456. https://doi.org/10.1111/asj.12445

Araujo, E. D., Costa, M., Chaud-Netto, J., & Fowler, H. G. (2004). Body size and flight distance in stingless bees (Hymenoptera : Meliponini): Inference of flight range and possible ecological implications. *Brazilian Journal of Biology*, *64*(3B), 563–568. https://doi.org/10.1590/S1519-69842004000400003

Araya, M., Morelli, L., Reid, G., Sanders, M. E., Stanton, C., Pineiro, M., & Ben Embarek, P. (2002). Guidelines for the evaluation of probiotics in food. In *Joint FAO/WHO Working Group Report on Drafting Guidelines for the Evaluation of Probiotics in Food*. https://doi.org/10.1111/j.1469-0691.2012.03873

Archer, A. C., & Halami, P. M. (2015). Probiotic attributes of *Lactobacillus fermentum* isolated from human feces and dairy products. *Applied Microbiology and Biotechnology*, *99*(19), 8113–8123. https://doi.org/10.1007/s00253-015-6679-x

Ares, A. M., Valverde, S., Bernal, J. L., Nozal, M. J., & Bernal, J. (2018). Extraction and determination of bioactive compounds from bee pollen. *Journal of Pharmaceutical and Biomedical Analysis*, *147*(2018), 110–124. https://doi.org/10.1016/j.jpba.2017.08.009

Asama, T., Arima, T., Gomi, T., Keishi, T., Tani, H., Kimura, Y., Tatefuji, T., & Hashimoto, K. (2015). *Lactobacillus kunkeei* YB38 from honeybee products enhances IgA production in healthy adults. *Journal of Applied Microbiology*, *119*, 818–826. https://doi.org/10.1111/jam.12889

Association of official Analytical Chemists. (2000). *Official methods of analysis of AOAC International* (17th ed). Association of Official Analytical Chemists. https://doi.org/10.5860/choice.35-0912

Azmi, W. A., Zulqurnain, N. S., & Ghazi, R. (2015). Melissopalynology and foraging activity of stingless bees, *Lepidotrigona Terminata* (Hymenoptera: Apidae) from an apiary in Besut, Terengganu. *Journal of Sustainability Science and Management*, *10*(1), 27–35.

Baccouri, O., Boukerb, A. M., Farhat, L. Ben, & Zébré, A. (2019). Probiotic potential and safety evaluation of *Enterococcus faecalis* OB14 and OB15 , isolated from traditional Tunisian Testouri Cheese and Rigouta , using physiological and genomic analysis sampling and isolation of lactic acid. *Frontiers in Microbiolology*, *10*(April), 1–15. https://doi.org/10.3389/fmicb.2019.00881

Bajpai, V. K., Rather, I. A., Majumder, R., Alshammari, F. H., Nam, G., & Park, Y. (2016). Characterization and antibacterial mode of action of lactic acid bacterium *Leuconostoc Mesenteroides* HJ69 from kimchi. *Journal of Food Biochemistry*, *41*(1), 1–11. https://doi.org/10.1111/jfbc.12290

Bakour, M., Al-Waili, N. S., El Menyiy, N., Imtara, H., Figuira, A. C., Al-Waili, T., & Lyoussi, B. (2017). Antioxidant activity and protective effect of bee bread (honey and pollen) in aluminum-induced anemia, elevation of inflammatory makers and hepato-renal toxicity. *Journal of Food Science and Technology*, *54*(13), 4205–4212. https://doi.org/10.1007/s13197-017-

2889-9

Bakour, M., Fernandes, Â., Barros, L., Sokovic, M., Ferreira, I. C. F. R., & Badiaa lyoussi. (2019). Bee bread as a functional product: Chemical composition and bioactive properties. *Lwt*, *109*, 276–282. https://doi.org/10.1016/j.lwt.2019.02.008

Baltrušaityte, V., Venskutonis, P. R., & Čeksteryte, V. (2007). Radical scavenging activity of different floral origin honey and beebread phenolic extracts. *Food Chemistry*, *101*(2), 502–514. https://doi.org/10.1016/j.foodchem.2006.02.007

Baltrušayt, V., Venskmonis, P. R., & Čeksteryte, V. (2007). Antibacterial activity of honey and beebread of different origin against *S. aureus* and *S. epidermidis*. *Food Technology and Biotechnology*, *45*(2), 201–208.

Bao, Y., Zhang, Y., Zhang, Y., Liu, Y., Wang, S., Dong, X., Wang, Y., & Zhang, H. (2010). Screening of potential probiotic properties of *Lactobacillus fermentum* isolated from traditional dairy products. *Food Control*, *21*(5), 695–701. https://doi.org/10.1016/j.foodcont.2009.10.010

Basari, N., Ramli, S. N., & Mohd Khairi, N. 'Aina S. (2018). Food reward and distance influence the foraging. *Insects*, *9*(138), 1–10. https://doi.org/10.3390/insects9040138

Belhadj, H., Harzallah, D., Khennouf, S., Dahamna, S., Bouharati, S., & Baghiani, A. (2010). Isolation, identification and antimicrobial activity of lactic acid bacteria from algerian honeybee collected pollen. *Acta Horticulturae*, *854*, 51–58. https://doi.org/10.17660/ActaHortic.2010.854.5

Belina-Aldemita, M. D., Opper, C., Schreiner, M., & D'Amico, S. (2019). Nutritional composition of pot-pollen produced by stingless bees (*Tetragonula biroi* Friese) from the Philippines. *Journal of Food Composition and Analysis*, *82*(June), 1-16. https://doi.org/10.1016/j.jfca.2019.04.003

Benton, D., Williams, C., & Brown, A. (2007). Impact of consuming a milk drink containing a probiotic on mood and cognition. *European Journal of Clinical Nutrition*, *61*(3), 355–361. https://doi.org/10.1038/sj.ejcn.1602546

Beric, T., Kojic, M., Stankovic, S., Topisirovic, L., Degrassi, G., Myers, M., Venturi, V., & Fira, D. (2012). Antimicrobial activity of *Bacillus* sp . natural isolates and their potential use in the biocontrol of phytopathogenic bacteria. *Food Technology and Biotechnology*, *50*(1), 25–31.

Bernama. (2019). *Sabah's stingless bee industry faces major challenges*. Bernama.

Berthold-Pluta, A., Pluta, A., & Garbowska, M. (2015). The effect of selected factors on the survival of *Bacillus cereus* in the human gastrointestinal tract. *Microbial Pathogenesis*, *82*, 7–14. https://doi.org/10.1016/j.micpath.2015.03.015

Bleha, R., Shevtsova, T., Kružik, V., Šorpilová, T., Saloň, I., Erban, V., Brindza, J., Brovarskyi, V., & Sinica, A. (2019). Bee breads from eastern Ukraine: Composition, physical properties and biological activities. *Czech Journal of Food Sciences*, *37*(1), 9–20. https://doi.org/10.17221/201/2018-CJFS

Bobis, O., Dezmirean, D., Al. Marghitas, L., Bonta, V., Margaoan, R., Pasca, C., Urcan, A., & PushpendraSingh, B. (2014). Beebread from *Apis mellifera* and *Apis dorsata.* Comparative chemical composition and bioactivity. *Bulletin UASVM Animal Science and Biotechnologies*, *71*(1), 250–255. https://doi.org/10.15835/buasvmcn-asb

Bogdanov, S. (2017). Pollen : Production , nutrition and health : A review. In *Bee Product Science* (pp. 1–36).

Bonvehı, J. S., & Escola, R. (1997). Nutrient composition and microbiological quality of honeybee-collected pollen in Spain. *J. Agric. Food Chem*, *45*(3), 725–732. https://doi.org/https://doi.org/10.1021/jf960265q

Budumajji, U., Jacob, A., & Raju, S. (2018). Pollination ecology of *Bidens pilosa* L.(*Asteraceae*). *Taiwania*, *63*(2), 89–100. https://doi.org/10.6165/tai.2018.63.89

Campos, M. G. R., Bogdanov, S., de Almeida-Muradian, L. B., Szczesna, T., Mancebo, Y., Frigerio, C., & Ferreira, F. (2008). Pollen composition and standardisation of analytical methods. *Journal of Apicultural Research*, *47*(2), 154–161. https://doi.org/10.3896/ibra.1.47.2.12

Carroll, M. J., Brown, N., Goodall, C., Downs, A. M., Sheenan, T. H., & Anderson, K. E. (2017). Honey bees preferentially consume freshly stored pollen. *PLoS ONE*, *12*(4), 1–21. https://doi.org/10.1371/journal.pone.0175933

Čeksterytė, V., Balžekas, J., Baltuškevičius, A., & Jurgevičius, E. (2012). The use of beebread-honey mixture in the treatment of liver diseases in alcohol-dependent patients. *Chemical Technology*, *60*(2). https://doi.org/10.5755/j01.ct.60.2.1930

Charteris, W. P., Kelly, P. M., Morelli, L., & Collins, J. K. (2001). Gradient diffusion antibiotic susceptibility testing of potentially probiotic. *Journal of Food Protection*, *64*(12), 2007–2014.

Chen, A. Y., & Chen, Y. C. (2014). A review of the dietary flavonoid, kaempferol on human health and cancer chemoprevention. *Food Chemistry*, *138*(4), 2099–2107. https://doi.org/10.1016/j.foodchem.2012.11.139.A

Chen, Y., Wang, L., Liao, Y., Lan, Y., Chang, C., Chang, Y., & Wu, H. (2017). *Lactobacillus musae* sp . nov ., a novel lactic acid bacterium isolated from banana fruits. *International Journal of Systematic*, *67*(12), 5144–5149. https://doi.org/10.1099/ijsem.0.002429

Chuttong, B., Phongphisutthinant, R., Sringarm, K., Burgett, M., & Barth, O. M. (2018). Nutritional composition of pot-pollen from four species of stingless bees (Meliponini) in Southeast Asia. In *Pot-Honey: A Legacy of Stingless Bees* (pp. 313–324). https://doi.org/10.1007/978-3-319-61839-5

Clinical and Laboratory Standards Institute. (2013). *M100-S23 Performance standards for antimicrobial* (Issue January). Clinical and Laboratory Standards Institute.

Collado, M. C., Meriluoto, J., & Salminen, S. (2008). Adhesion and aggregation properties of probiotic and pathogen strains. *European Food Research and Technology*, *226*(5), 1065–1073. https://doi.org/10.1007/s00217-007-0632-x

Combey, R. (2017). Microbial and qualitative analyses of stingless bee bread using dry preservation methods. *Euro J Zool Res*, *5*(1), 45–50. www.ischolarsresearchlibrary.com

Contreras-Oliva, A., Pérez-Sato, J. A., Gómez-Merino, F. C., López-Garay, L. A., Villanueva-Gutiérrez, R., Crosby-Galván, M. M., & Trejo-Téllez, L. I. (2018). Characterization of *Scaptotrigona mexicana* pot-pollen from Veracruz, Mexico. In *Pot-Pollen in Stingless Bee Melittology* (pp. 325–337). https://doi.org/10.1007/978-3-319-61839-5_23

Coppola, R., Succi, M., Tremonte, P., Reale, A., Salzano, G., & Sorrentino, E. (2005). Antibiotic susceptibility of *Lactobacillus rhamnosus* strains isolated from Parmigiano Reggiano cheese. *Lait*, *85*(4), 193–204. https://doi.org/10.1051/lait

Corby-Harris, V., Maes, P., & Anderson, K. E. (2014). The bacterial communities associated with honey bee (*Apis mellifera*) foragers. *PLoS ONE*, *9*(4). https://doi.org/10.1371/journal.pone.0095056

Costabile, A., Buttarazzi, I., Kolida, S., Quercia, S., Baldini, J., Swann, J. R., Brigidi, P., & Gibson, G. R. (2017). An *in vivo* assessment of the cholesterol-lowering efficacy of *Lactobacillus plantarum* ECGC 13110402 in normal to mildly hypercholesterolaemic adults. *PLoS ONE*, *12*(12), 1–21. https://doi.org/10.1371/journal.pone.0187964

Cotter, P. D., & Hill, C. (2003). Surviving the acid test: responses of Gram-positive bacteria to low pH. *Microbiology and Molecular Biology Reviews*, *67*(3), 429–453. https://doi.org/10.1128/MMBR.67.3.429

D'Amato, G., Liccardi, G., & Frenguelli, G. (2007). Thunderstorm-asthma and pollen allergy. *Allergy: European Journal of Allergy and Clinical Immunology*, *62*(1), 11–16. https://doi.org/10.1111/j.1398-9995.2006.01271.x

D'Argenio, V., & Salvatore, F. (2015). The role of the gut microbiome in the healthy adult status. *Clinica Chimica Acta*, *451*(2014), 97–102. https://doi.org/10.1016/j.cca.2015.01.003

da Silva, G. R., da Natividade, T. B., Camara, C. A., da Silva, E. M. S., Santos, F. de A. R. dos, & Silva, T. M. S. (2014). Identification of sugar , amino acids and minerals from the pollen of Jandaíra stingless bees (*Melipona subnitida*). *Food and Nutrition Sciences*, *5*(11), 1015–1021. https://doi.org/http://dx.doi.org/10.4236/fns.2014.511112

Daliri, E. B.-M., Lee, B. H., & Oh, D. H. (2019). Safety of probiotics in health and disease. In *The Role of Functional Food Security in Global Health* (1st Ed, pp. 603–622). Academic Press. https://doi.org/10.1016/b978-0-12-813148-0.00034-7

Daniel, H. M., Rosa, C. A., Thiago-Calaça, P. S. S., Antonini, Y., Bastos, E. M. A. F., Evrard, P., Huret, S., Fidalgo-Jiménez, A., & Lachance, M. A. (2013). *Starmerella neotropicalis* f. a., sp. nov., a yeast species found in bees and pollen. *International Journal of Systematic and Evolutionary Microbiology*, *63*(10), 3896–3903. https://doi.org/10.1099/ijs.0.055897-0

de Arruda, V. A. S., Pereira, A. A. S., de Freitas, A. S., Barth, O. M., & de Almeida-Muradian, L. B. (2013). Dried bee pollen: B complex vitamins, physicochemical and botanical composition. *Journal of Food Composition and Analysis*, *29*(2), 100–105. https://doi.org/10.1016/j.jfca.2012.11.004

de Paula, A. T., Jeronymo-Ceneviva, A. B., Silva, L. F., Todorov, S. D., Franco, B. D. G. M., & Penna, A. L. B. (2015). *Leuconostoc mesenteroides* SJRP55: a potential probiotic strain isolated from Brazilian water buffalo mozzarella cheese. *Annals of Microbiology*, *65*(2), 899–910. https://doi.org/10.1007/s13213-014-0933-9

de Souza, R. R., de Abreu, V. H. R., & de Novais, J. S. (2019). Melissopalynology in Brazil: a map of pollen types and published productions between 2005 and 2017. *Palynology*, *43*(4), 690–700. https://doi.org/10.1080/01916122.2018.1542355

Degrandi-Hoffman, G., Eckholm, B. J., & Huang, M. H. (2013). A comparison of bee bread made by Africanized and European honey bees (*Apis mellifera*) and its effects on hemolymph protein titers. *Apidologie*, *44*(1), 52–63. https://doi.org/10.1007/s13592-012-0154-9

Denisow, B., & Denisow-Pietrzyk, M. (2016). Biological and therapeutic properties of bee pollen: a review. *Journal of the Science of Food and Agriculture*, *96*(13), 4303–4309. https://doi.org/10.1002/jsfa.7729

Diana, C.-R., Humberto, H.-S., & Jorge, Y. F. (2015). Probiotic Properties of *Leuconostoc mesenteroides* isolated from Aguamiel of Agave salmiana. *Probiotics and Antimicrobial Proteins*, *7*(2), 107–117. https://doi.org/10.1007/s12602-015-9187-5

Disayathanoowat, T., Li, H., Supapimon, N., Suwannarach, N., Lumyong, S., Chantawannakul, P., & Guo, J. (2020). Different dynamics of bacterial and fungal communities in hive stored bee bread and their possible roles : A case study from two commercial honey bees in China. *Microorgnaisms*, *8*(264), 1–21.https:doi.org/10.3390/microorganisms8020264

Dlamini, Z. C., Langa, R. L. S., & Aiyegoro, O. A. (2018). Safety evaluation and colonisation abilities of four lactic acid bacteria as future probiotics. *Probiotics and Antimicrobial Proteins*, *11*(2). https://doi.org/10.1007/s12602-018-9430-y

Donkersley, P., Rhodes, G., Pickup, R. W., Jones, K. C., & Wilson, K. (2018). Bacterial communities associated with honeybee food stores are correlated with land use. *Ecology and Evolution*, *8*(10), 4743–4756. https://doi.org/10.1002/ece3.3999

Doron, S., & Snydman, D. R. (2015). Risk and safety of probiotics. *Clinical Infectious Diseases*, *60*(Suppl 2), S129–S134. https://doi.org/10.1093/cid/civ085

Doron, S., Snydman, D. R., & Gorbach, S. L. (2005). *Lactobacillus* GG: Bacteriology and clinical applications. *Gastroenterology Clinics of North America*, *34*(3), 483–498. https://doi.org/10.1016/j.gtc.2005.05.011

Ehrmann, M. A., Müller, M. R. A., & Vogel, R. F. (2003). Molecular analysis of sourdough reveals *Lactobacillus mindensis* sp. nov. *International Journal of Systematic and Evolutionary Microbiology*, *53*(1), 7–13. https://doi.org/10.1099/ijs.0.02202-0

Eliopoulos, G. M., Cosgrove, S. E., & Carmeli, Y. (2003). The impact of antimicrobial resistance on health and economic outcomes. *Clinical Infectious Diseases*, *36*(11), 1433–1437. https://doi.org/10.1086/375081

Elshaghabee, F. M. F., Rokana, N., Gulhane, R. D., Sharma, C., & Panwar, H. (2017). *Bacillus* as potential probiotics: Status, concerns, and future perspectives. *Frontiers in Microbiology*, *8*(Aug), 1–15. https://doi.org/10.3389/fmicb.2017.01490

Endo, A., Futagawa-Endo, Y., & Dicks, L. M. T. (2009). Isolation and characterization of fructophilic lactic acid bacteria from fructose-rich niches. *Systematic and Applied Microbiology*, *32*(8), 593–600. https://doi.org/10.1016/j.syapm.2009.08.002

Endo, A., & Salminen, S. (2013). Honeybees and beehives are rich sources for fructophilic lactic acid bacteria. *Systematic and Applied Microbiology*, *36*(6), 444–448. https://doi.org/10.1016/j.syapm.2013.06.002

Engel, P., Martinson, V. G., & Moran, N. A. (2012). Functional diversity within the simple gut microbiota of the honey bee. *Proceedings of the National Academy of Sciences*, *109*(27), 11002–11007. https://doi.org/10.1073/pnas.1202970109

Esawy, M. A., Awad, G. E. A., Ahmed, E. F., Danial, E. N., & Mansour, N. M. (2012). Evaluation of honey as a new reservoir for probiotic bacteria. *Advances in Food Sciences Journal*, *34*(November), 72–81. https://www.researchgate.net/publication/242656081_Evaluation_of_honey_as_a_new_reservoir_for_probiotic_bacteria

Estevinho, L. M., Rodrigues, S., Pereira, A. P., & Feás, X. (2012). Portuguese bee pollen: Palynological study, nutritional and microbiological evaluation. *International Journal of Food Science and Technology*, *47*(2), 429–435. https://doi.org/10.1111/j.1365-2621.2011.02859.x

Feás, X., Vázquez-tato, M. P., Estevinho, L., Seijas, J. A., & Iglesias, A. (2012). Organic bee pollen: Botanical origin, nutritional value, bioactive compounds, antioxidant activity and microbiological quality. *Molecules*, *17*(7), 8359–8377. https://doi.org/10.3390/molecules17078359

Fernandez, M., & Zúñiga, M. (2006). Amino acid catabolic pathways of lactic acid bacteria. *Critical Reviews in Microbiology*, *32*(3), 155–183. https://doi.org/10.1080/10408410600880643

Fijan, S. (2014). Microorganisms with claimed probiotic properties: An overview of recent literature. *International Journal of Environmental Research and Public Health*, *11*(5), 4745–4767. https://doi.org/10.3390/ijerph110504745

Fijan, S. (2016). Antimicrobial effect of probiotics against common pathogens. In *Probiotics and Prebiotics in Human Nutrition and Health* (pp. 191–221).IntechOpen Limited. https://doi.org/10.5772/63141

Firouzi, S., Majid, H. A., Ismail, A., Kamaruddin, N. A., & Barakatun-Nisak, M. Y. (2017). Effect of multi-strain probiotics (multi-strain microbial cell preparation) on glycemic control and other diabetes-related outcomes in people with type 2 diabetes: a randomized controlled trial. *European Journal of Nutrition*, *56*(4), 1535–1550. https://doi.org/10.1007/s00394-016-1199-8

Food Act 1983 Food (Amendment) (No. 3) Regulations 2014 (Issue 3, pp. 1–45). (2014).

Forssten, D., Sindelar, C. W., & Ouwehand, A. C. (2011). Probiotics from an industrial perspective. *Anaerobe*, *17*(2011), 410–413. https://doi.org/10.1016/j.anaerobe.2011.04.014

Fortune Business Insights. (2019). *Global probiotic market analysis, insights and forecast 2014-2025*. Fortune Business Insights.

Fukao, M., Zendo, T., Inoue, T., Nakayama, J., Suzuki, S., Fukaya, T., Yajima, N., & Sonomoto, K. (2019). Plasmid-encoded glycosyltransferase operon is responsible for exopolysaccharide production, cell aggregation, and bile resistance in a probiotic strain, *Lactobacillus brevis* KB290. *Journal of Bioscience and Bioengineering*, *128*(4), 391–397. https://doi.org/10.1016/j.jbiosc.2019.04.008

Fuller, R. (1989). Probiotics in man and animals. *Journal of Applied Bactreiology*, *66*(5), 365–378.

Gahan, C. G. M., & Hill, C. (2005). The interaction between bacteria and bile. *FEMS Microbiology Reviews*, *29*(4), 625–651. https://doi.org/10.1016/j.femsre.2004.09.003

García-Ruiz, A., González de Llano, D., Esteban-Fernández, A., Requena, T., Bartolomé, B., & Moreno-Arribas, M. V. (2014). Assessment of probiotic properties in lactic acid bacteria isolated from wine. *Food Microbiology*, *44*(December), 220–225. https://doi.org/10.1016/j.fm.2014.06.015

Gareau, M. G., Sherman, P. M., & Walker, W. A. (2010). Probiotics and the gut microbiota in intestinal health and disease. *Nature Reviews Gastroenterology and Hepatology*, *7*(9), 503–514. https://doi.org/10.1038/nrgastro.2010.117

Ghazi, R., Zulqurnain, N. S., & Azmi, W. A. (2018). Melittopalynological studies of stingless bees from the East Coast of Peninsular Malaysia. In *Pot-Pollen in Stingless Bee Melittology* (pp. 77–88). Springer. https://doi.org/10.1007/978-3-319-61839-5

Giles-Gómez, M., Sandoval García, J. G., Matus, V., Campos Quintana, I., Bolívar, F., & Escalante, A. (2016). *In vitro* and *in vivo* probiotic assessment of *Leuconostoc mesenteroides* P45 isolated from pulque, a Mexican traditional alcoholic beverage. *SpringerPlus*, *5*(1). https://doi.org/10.1186/s40064-016-2370-7

Gilliam, M. (1979). Microbiology of Pollen and Bee bread: The Yeasts. *Apidologie*, *10*(1), 43–53. https://doi.org/https://doi.org/10.1051/apido:19790106

Gilliam, M, Rubik, D., & Lorenz, B. (2000). Microorganisms associated with pollen, honey and brood provisions in the nest of a stingless bee, *Melipona fasciata*. *Apidologie*, *21*, 89–97. https://doi.org/https://doi.org/10.1051/apido:19900201

Gilliam, Martha. (1979). Microbiology of pollen and bee bread : the genus *Bacillus*. *Apidologie*, *10*(3), 269–274. https://doi.org/10.1051/apido:19790304

Golubkina, N. A., Sheshnitsan, S. S., Kapitalchuk, M. V., & Erdenotsogt, E. (2016). Variations of chemical element composition of bee and beekeeping products in different taxons of the biosphere. *Ecological Indicators*, *66*, 452–457. https://doi.org/10.1016/j.ecolind.2016.01.042

Gorbach, S., Doron, S., & Magro, F. (2016). Chapter 7 - *Lactobacillus rhamnosus* GG. In *The Microbiota in Gastrointestinal Pathophysiology*. Academic Press. https://doi.org/10.1016/B978-0-12-804024-9/00007-0

Graikou, K., Kapeta, S., Aligiannis, N., Sotiroudis, G., Chondrogianni, N., Gonos, E., & Chinou, I. (2011). Chemical analysis of Greek pollen - Antioxidant, antimicrobial and proteasome activation properties. *Chemistry Central Journal*, *5*(1), 33. https://doi.org/10.1186/1752-153X-5-33

Granato, D., Branco, G. F., Nazzaro, F., Cruz, A. G., & Faria, J. A. F. (2010). Functional foods and nondairy probiotic food development: Trends, concepts, and products. *Comprehensive Reviews in Food Science and Food Safety*, *9*(3), 292–302. https://doi.org/10.1111/j.1541-4337.2010.00110.x

Grigoryan, S., Bazukyan, I., & Trchounian, A. (2017). Aggregation and adhesion activity of *Lactobacilli* isolated from fermented products *in vitro* and *in vivo*: a potential probiotic strain. *Probiotics & Health*, *10*(2), 269–276. https://doi.org/10.1007/s12602-017-9283-9

Grześkowiak, Ł., Collado, M. C., & Salminen, S. (2012). Evaluation of aggregation abilities between commensal fish bacteria and pathogens. *Aquaculture*, *356* , 412–414. https://doi.org/10.1016/j.aquaculture.2012.04.015

Gualerzi, C. O., & Brandi, L. (2014). *Antibiotics: Targets, mechanisms and resistance*. Wiley-VCH.

Guarner, F., & Schaafsma, G. J. (1998). Probiotics. *International Journal of Food Microbiology*, *39*, 237–238. https://doi.org/10.1016/s0168-1605(97)00136-0

Gueimonde, M., Sánchez, B., de los Reyes-Gavilán, C. G., & Margolles, A. (2013). Antibiotic resistance in probiotic bacteria. *Frontiers in Microbiology*, *4*(JUL), 1–6. https://doi.org/10.3389/fmicb.2013.00202

Guo, Z., Wang, J., Yan, L., Chen, W., Liu, X. ming, & Zhang, H. ping. (2009). In vitro comparison of probiotic properties of *Lactobacillus casei* Zhang, a potential new probiotic, with selected probiotic strains. *LWT - Food Science and Technology*, *42*(10), 1640–1646. https://doi.org/10.1016/j.lwt.2009.05.025

Gupta, V., & Garge, R. (2009). Probiotics. *Indian Journal of Medical Microbiology*, *27*(3), 202–210. https://doi.org/IndianJMedMicrobiol_2009_27_3_202_53201 [pii]\r10.4103/0255-0857.53201

Haitham, A. R., Zaiton, H., Norrakiah, A. S., & Huda-Faujan, N. (2017). Assessment of potential probiotic properties lactic acid bacteria from shrimp paste or belacan. *International Journal of Advances in Science Engineering and Technology*, *5*(1), 90–98.

Hamid, S. A., Salleh, M. S., Thevan, K., & Hashim, N. A. (2016). Distribution and morphometrical variations of stingless bees (Apidae : Meliponini) in urban and forest areas of Penang Island , Malaysia. *Journal of Tropical Resources and Sustainable Science*, *4*, 1–5.

Hamid, Z. A. (2019). Stingless bees the next “super food” industry. *News Strait Times*.

Han, Q., Kong, B., Chen, Q., Sun, F., & Zhang, H. (2017). *In vitro* comparison of probiotic properties of lactic acid bacteria isolated from Harbin dry sausages and selected probiotics. *Journal of Functional Foods*, *32*, 391–400. https://doi.org/10.1016/j.jff.2017.03.020

Handa, S., & Sharma, N. (2016). A study on bacteriocin produced from a novel strain of *Lactobacillus crustorum* F11 isolated from human milk. *Proceedings of the Indian National Science Academy*, *82*(4), 1317–1322. https://doi.org/10.16943/ptinsa/2016/v82/48405

Harzallah, D., & Belhadj, H. (2013). Lactic acid bacteria as probiotics : Characteristics , selection criteria and role in immunomodulation of human GI muccosal barrier. In *Lactic Acid Bacteria - R & D for Food, Health and Livestock Purposes* (pp. 197–216). InTech. https://doi.org/DOI: 10.5772/50732

Hasanuzzaman, M., Bhuyan, M. H. M. B., Nahar, K., Hossain, M. S., Al Mahmud, J., Hossen, M. S., Masud, A. A. C., Moumita, & Fujita, M. (2018). Potassium: A vital regulator of plant responses and tolerance to abiotic stresses. *Agronomy*, *8*(3). https://doi.org/10.3390/agronomy8030031

Hasler, C. M. (2002). Functional foods: Benefits, concerns and challenges—A position paper from the American Council on science and health. *The Journal of Nutrition*, *132*(12), 3772–3781. https://doi.org/10.1093/jn/132.12.3772

Havenaar, R., & Huis in't Veld, J. H. J. (1992). Probiotics : A General View. In *The Lactic Acid Bacteria in Health and Disease* (Vol. 1, pp. 151–170). Elsevier Applied Science.

Haydak, M. H., & Palmer, L. S. (1942). Royal jelly and bee bread as Sources of vitamins B1, B2, B6, C, and nicotinic and pantothenic acids. *Journal of Economic Entomology*, *35*(3), 319–320. https://doi.org/10.1093/jee/35.3.319

Haydak, M. H., & Vivino, A. E. (1950). The changes in the thiamine, riboflavin, niacin and pantothenic acid content in the food of female honeybees during growth with a note on the vitamin K activity of royal jelly and beebread. *Annals of the Entomological Society of America*, *43*(3), 361–367. https://doi.org/10.1093/aesa/43.3.361

Hayden, C., Road, E. A., & Gilliam, M. (2000). Identifiation and roles of non-pathogenic microflora associated with honey bees. *FEMS Microbiology Letters*, *155*(1), 1–10. https://doi.org/https://doi.org/10.1016/S0378-1097(97)00337-6

Heard, T. (2016). *The Australian native bee book: Keeping stingless bee hives for pets, pollination and delectable sugarbag honey*. Sugarbag Bees.

Hempel, S., Newberry, S., Ruelaz, A., Wang, Z., Miles, J. N. V., Suttorp, M. J., Johnsen, B., Shanman, R., Slusser, W., Fu, N., Smith, A., Roth, B., Polak, J., Motala, A., Perry, T., & Shekelle, P. G. (2011). Safety of probiotics used to reduce risk and prevent or treat disease. *Evidence Report/Technology Assessment*, *200*, 1–645. https://pubmed.ncbi.nlm.nih.gov/23126627/

Herbert, E. W., Bee, B., & Shimanuki, H. (1978). Chemical composition and nutritive value of bee-collected and bee-stored pollen. *Apidologie*, *9*(1), 33–40. https://doi.org/https://doi.org/10.1051/apido:19780103

Hesse, M., Halbritter, H., Zetter, R., Weber, M., Buchner, R., Frosch-Radivo, A., & Ulrich, S. (2009). *Pollen terminology: An illustrated handbook*. Springer Science & Business Media.

Hudz, N., Ivanova, R., Brindza, J., Grygorieva, O., Schubertová, Z., & Ivanišová, E. (2017). Approaches to the determination of antioxidant activity of extracts from bee bread and safflower leaves and flowers. *Potravinarstvo Slovak Journal of Food Sciences*, *11*(1), 480–488. https://doi.org/10.5219/786

Human, H., & Nicolson, S. W. (2006). Nutritional content of fresh, bee-collected and stored pollen of *Aloe greatheadii* var. *davyana* (Asphodelaceae). *Phytochemistry*, *67*(14), 1486–1492. https://doi.org/10.1016/j.phytochem.2006.05.023

Hummel, A. S., Hertel, C., Holzapfel, W. H., & Franz, C. M. A. P. (2007). Antibiotic resistances of starter and probiotic strains of lactic acid bacteria. *Applied and Environmental Microbiology*, *73*(3), 730–739. https://doi.org/10.1128/AEM.02105-06

Hungin, A. P. S., Mulligan, C., Pot, B., Whorwell, P., Agréus, L., Fracasso, P., Lionis, C., Mendive, J., Philippart De Foy, J. M., Rubin, G., Winchester, C., & De Wit, N. (2013). Systematic review: Probiotics in the management of lower gastrointestinal symptoms in clinical practice - An evidence-based international guide. *Alimentary Pharmacology and Therapeutics*, *38*(8), 864–886. https://doi.org/10.1111/apt.12460

Hussein, Z., Taher, S. W., Gilcharan Singh, H. K., & Chee Siew Swee, W. (2015). Diabetes care in Malaysia: Problems, new models, and solutions. *Annals of Global Health*, *81*(6), 851–862. https://doi.org/10.1016/j.aogh.2015.12.016

Ibrahim, I. F., Balasundram, S. K., Abdullah, N. A. P., Alias, M. S., & Mardan, M. (2012). Morphological characterization of pollen collected by *Apis Dorsata* from tropical rainforest. *International Journal of Botany*, *8*(3), 96–106. https://doi.org/DOI: 10.3923/ijb.2012.96.106

Ida Muryany, M. Y., Ina Salwany, M. Y., Ghazali, A. R., Hing, H. L., & Nor Fadilah, R. (2017). Identification and characterization of the lactic acid bacteria isolated from Malaysian fermented fish (Pekasam). *International Food Research Journal*, *24*(April), 868–875.

Institute of Medicine. (2000). *Dietary reference intakes for vitamin C, vitamin E, selenium, and carotenoids : a report of the Panel on Dietary Antioxidants and Related Compounds, Subcommittees on Upper Reference Levels of Nutrients and of Interpretation and Use of Dietary Reference In*. National Academy Press.

Isidorov, V. A., Isidorova, A. G., Sczczepaniak, L., & Czyzewska, U. (2009). Gas chromatographic-mass spectrometric investigation of the chemical composition of beebread. *Food Chemistry*, *115*(3), 1056–1063. https://doi.org/10.1016/j.foodchem.2008.12.025

Ismail, M. M. (2014). *Competitiveness of beekeeping industry in Malaysia*. Universiti Putra Malaysia Press.

Ismail, M. M., & Ismail, W. I. W. (2018). Development of stingless beekeeping projects in Malaysia. *E3S Web of Conferences*, *52*, 1–5. https://doi.org/10.1051/e3sconf/20185200028

Ismail, W. I. W. (2016). A review on beekeping in Malaysia: History, importance and future directions. *Journal of Sustainability Science and Management*, *11*(2), 70–80. http://jssm.umt.edu.my/wp-content/uploads/sites/51/2016/12/8-web.pdf

Ismail, W. I. W., Hussin, N. N., Mazlan, S. N. F., Hussin, N. H., & Mohd Radzi, M. N. F. (2018). Physicochemical analysis , antioxidant and anti proliferation activities of honey , propolis and beebread harvested from stingless bee. *IOP Conf. Series: Materials Science and Engineering*, *440*(1), 1–7. https://doi.org/10.1088/1757-899X/440/1/012048

Ivanišová, E., Kačániová, M., Frančáková, H., Petrová, J., Hutková, J., Brovarskyi, V., Velychko, S., Adamchuk, L., Schubertová, Z., & Musilová, J. (2015). Bee bread - Perspective source of bioactive compounds for future. *Potravinarstvo*, *9*(1), 592–598. https://doi.org/10.5219/558

Jaapar, M. F., Halim, M., Mispan, M. R., Jajuli, R., Saranum, M. M., Zainuddin, M. Y., Ghazi, R., & Abd Ghani, I. (2016). The diversity and abundace of stingless bee (Hymenoptera: Meliponini) in Peninsular Malaysia. *Advance in Environmental Biology*, *10*(9), 1–7. http://www.aensiweb.net/AENSIWEB/aeb/aeb/2016/September/1-7.PDF

Jaapar, M. F., Jajuli, R., & Mispan, M. R. (2015). *Lebah kelulut Malaysia: Biologi dan penternakan*. PENERBIT MARDI.

Janashia, I., & Alaux, C. (2016). Specific immune stimulation by endogenous bacteria in honey bees (Hymenoptera: Apidae). *Journal of Economic Entomology*, *109*(3), 1474–1477. https://doi.org/10.1093/jee/tow065

Janashia, I., Carminati, D., Rossetti, L., Zago, M., Fornasari, M. E., Haertlé, T., Chanishvili, N., & Giraffa, G. (2016). Characterization of fructophilic lactic microbiota of *Apis mellifera* from the Caucasus Mountains. *Annals of Microbiology*, *66*(4), 1387–1395. https://doi.org/10.1007/s13213-016-1226-2

Janashia, I., Choiset, Y., Jozefiak, D., Déniel, F., Coton, E., Moosavi-Movahedi, A. A., Chanishvili, N., & Haertlé, T. (2018). Beneficial protective role of endogenous lactic acid bacteria against mycotic contamination of honeybee beebread. *Probiotics and Antimicrobial Proteins*, *10*(4), 638–646. https://doi.org/10.1007/s12602-017-9379-2

Janda, J. M., & Abbott, S. L. (2007). 16S rRNA gene sequencing for bacterial identification in the diagnostic laboratory: Pluses, perils, and pitfalls. *Journal of Clinical Microbiology*, *45*(9), 2761–2764. https://doi.org/10.1128/JCM.01228-07

Jessberger, N., Dietrich, R., Schwemmer, S., Tausch, F., Schwenk, V., Didier, A., & Märtlbauer, E. (2019). Binding to the target cell surface is the crucial step in pore formation of hemolysin BL from *Bacillus cereus*. *Toxins*, *11*(5). https://doi.org/10.3390/toxins11050281

Jiang, M., Zhang, F., Wan, C., Xiong, Y., Shah, N. P., Wei, H., & Tao, X. (2016). Evaluation of probiotic properties of *Lactobacillus plantarum* WLPL04 isolated from human breast milk. *Journal of Dairy Science*, *99*(3), 1736–1746. https://doi.org/10.3168/jds.2015-10434

Jones, G. D., & Bryant, V. M. (2007). A comparison of pollen counts: Light versus scanning electron microscopy. *Grana*, *46*(1), 20–33. https://doi.org/10.1080/00173130601173897

Jose, N. M., Bunt, C. R., Hussain, M. A., Maria, N., Bunt, C. R., Implications, M. A. H., Jose, N. M., Bunt, C. R., & Hussain, M. A. (2015). Implications of antibiotic resistance in probiotics. *Food Reviews International*, *31*(1), 52–62. https://doi.org/10.1080/87559129.2014.961075

Joshi, S., Udani, S., Sen, S., Kirolikar, S., & Shetty, A. (2019). *Bacillus clausii* Septicemia in a pediatric patient after treatment with probiotics. *Pediatric Infectious Disease Journal*, *38*(9), E228–E230. https://doi.org/10.1097/INF.0000000000002350

Kaplan, M., Karaoglu, Ö., Eroglu, N., & Silici, S. (2016). Fatty acid and proximate composition of bee bread. *Food Technology and Biotechnology*, *54*(4), 497–504. https://doi.org/10.17113/ft b.54.04.16.4635

Kato-Kataoka, A., Nishida, K., Takada, M., Suda, K., Kawai, M., Shimizu, K., Kushiro, A., Hoshi, R., Watanabe, O., Igarashi, T., Miyazaki, K., Kuwano, Y., & Rokutan, K. (2016). Fermented milk containing *Lactobacillus casei* strain Shirota prevents the onset of physical symptoms in medical students under academic examination stress. *Beneficial Microbes*, *7*(2), 153–156. https://doi.org/10.3920/BM2015.0100

Kavitha, M., Raja, M., & Perumal, P. (2018). Evaluation of probiotic potential of *Bacillus* spp . isolated from the digestive tract of freshwater fish Labeo calbasu (Hamilton , 1822). *Aquaculture Reports*, *11*(July), 59–69. https://doi.org/10.1016/j.aqrep.2018.07.001

Kazemi, A., Noorbala, A. A., Azam, K., Eskandari, M. H., & Djafarian, K. (2018). Effect of probiotic and prebiotic vs placebo on psychological outcomes in patients with major depressive disorder : A randomized clinical. *Clinical Nutrition*, 1–7. https://doi.org/10.1016/j.clnu.2018.04.010

Kechagia, M., Basoulis, D., Konstantopoulou, S., Dimitriadi, D., Gyftopoulou, K., Skarmoutsou, N., & Fakiri, E. M. (2013). Health benefits of probiotics: A review. *ISRN Nutrition*, *2013*, 1–7. https://doi.org/10.5402/2013/481651

Kešnerová, L., Mars, R. A. T., Ellegaard, K. M., Troilo, M., Sauer, U., & Engel, P. (2017). Disentangling metabolic functions of bacteria in the honey bee gut. *PLoS Biology*, *15*(12), 1–28. https://doi.org/10.1371/journal.pbio.2003467

Khalesi, S., Bellissimo, N., Vandelanotte, C., Williams, S., Stanley, D., & Irwin, C. (2019). A review of probiotic supplementation in healthy adults: helpful or hype? *European Journal of Clinical Nutrition*, *73*(1), 24–37. https://doi.org/10.1038/s41430-018-0135-9

Kieliszek, M., Piwowarek, K., Kot, A. M., Błażejak, S., Chlebowska-Śmigiel, A., & Wolska, I. (2018). Pollen and bee bread as new health-oriented products: A review. *Trends in Food Science and Technology*, *71*(July), 170–180. https://doi.org/10.1016/j.tifs.2017.10.021

Kiew, R., & Muid, M. (1991). *Beekeeping in Malaysia: Pollen atlas* (Issue May). Malaysian Beekeeping Research and Development Team.

Klatt, B. K., Holzschuh, A., Westphal, C., Clough, Y., Smit, I., Pawelzik, E., & Tscharntke, T. (2014). Bee pollination improves crop quality , shelf life and commercial value. *Proceedings of the Royal Society B*, *281*(1775), 1–8. https://doi.org/http://dx.doi.org/10.1098/rspb.2013.2440

Klein, G., Hallmann, C., Casas, I. A., Abad, J., Louwers, J., & Reuter, G. (2000). Exclusion of vanA, vanB and vanC type glycopeptide resistance in strains of *Lactobacillus reuteri* and *Lactobacillus rhamnosus* used as probiotics by polymerase chain reaction and hybridization methods. *Journal of Applied Microbiology*, *89*(5), 815–824. https://doi.org/10.1046/j.1365-2672.2000.01187.x

Komosinska-Vassev, K., Olczyk, P., Kaźmierczak, J., Mencner, L., & Olczyk, K. (2015). Bee pollen: Chemical composition and therapeutic application. *Evidence-Based Complementary and Alternative Medicine*, *2015*. https://doi.org/10.1155/2015/297425

Kos, B., Suskovic, J., Vukovic, S., Simpraga, M., Frece, J., & Matosic, S. (2003). Adhesion and aggregation ability of probiotic strain *Lactobacillus acidophilus* M92. *Journal of Applied Microbiology*, *94*(6), 981–987. https://doi.org/10.1046/j.1365-2672.2003.01915.x

Kostić, A. Ž., Barać, M. B., Stanojević, S. P., Milojković-Opsenica, D. M., Tešić, Ž. L., Šikoparija, B., Radišić, P., Prentović, M., & Pešić, M. B. (2015). Physicochemical composition and techno-functional properties of bee pollen collected in Serbia. *LWT - Food Science and Technology*, *62*(1), 301–309. https://doi.org/10.1016/j.lwt.2015.01.031

Kostić, A. Ž., Milinčić, D. D., Petrović, T. S., Krnjaja, V. S., Stanojević, S. P., Barać, M. B., Tešić, Ž. L., & Pešić, M. B. (2019). Mycotoxins and mycotoxin producing fungi in pollen: Review. *Toxins*, *11*(2). https://doi.org/10.3390/toxins11020064

Kostić, A. Ž., Pešić, M. B., Mosić, M. D., Dojèinović, B. P., Natić, M. M., & Trifković, J. D. (2015). Mineral content of bee pollen from Serbia. *Arhiv Za Higijenu Rada i Toksikologiju*, *66*(4), 251–258. https://doi.org/10.1515/aiht-2015-66-2630

Kothari, D., Patel, S., & Kim, S. K. (2019). Probiotic supplements might not be universally-effective and safe: A review. *Biomedicine and Pharmacotherapy*, *111*(December 2018), 537–547. https://doi.org/10.1016/j.biopha.2018.12.104

Koyama, S., Fujita, H., Shimosato, T., Kamijo, A., Ishiyama, Y., Yamamoto, E., Ishii, Y., Hattori, Y., Hagihara, M., Yamazaki, E., Tomita, N., & Nakajima, H. (2019). Septicemia from *Lactobacillus rhamnosus* GG, from a probiotic enriched yogurt, in a patient with autologous stem cell transplantation. *Probiotics and Antimicrobial Proteins*, *11*(1), 295–298. https://doi.org/10.1007/s12602-018-9399-6

Kristoffersen, S. M., Ravnum, S., Tourasse, N. J., Økstad, O. A., Kolstø, A. B., & Davies, W. (2007). Low concentrations of bile salts induce stress responses and reduce motility in *Bacillus cereus* ATCC 14570. *Journal of Bacteriology*, *189*(14), 5302–5313. https://doi.org/10.1128/JB.00239-07

Kuzin, A. P., Sun, T., Jorczak-baillass, J., Healy, V. L., Walsh, C. T., & Knox, J. R. (2000). Enzymes of vancomycin resistance : the structure of D -alanine – D - lactate ligase of naturally resistant *Leuconostoc mesenteroides*. *Structure*, *8*(5), 463–470. https://doi.org/10.1016/S0969-2126(00)00129-5

Kwong, W. K., Medina, L. A., Koch, H., Sing, K. W., Soh, E. J. Y., Ascher, J. S., Jaffé, R., & Moran, N. A. (2017). Dynamic microbiome evolution in social bees. *Science Advances*, *3*(3), 1–17. https://doi.org/10.1126/sciadv.1600513

Kwong, W. K., & Moran, N. A. (2016). Gut microbial communities of social bees. *Nature Publishing Group*, 1–11. https://doi.org/10.1038/nrmicro.2016.43

Lamari, F., Khouadja, S., & Rtimi, S. (2018). Interaction of Vibrio to biotic and abiotic surfaces: Relationship between hydrophobicity, cell adherence, biofilm production, and cytotoxic activity. *Surfaces*, *1*(1), 187–201. https://doi.org/10.3390/surfaces1010014

Lani, M., Mohd Hasali, N., Zamri, A., Mubarak, A., & Suhaili, Z. (2015). Identification of lactic acid bacteria from Meliponine honey and their antimicrobial activity against pathogenic bacteria. *American-Eurasian Journal of Sustainable Agriculture*, *9*(6), 1–6.

Laranjo, M., Córdoba, M. D. G., Semedo-Lemsaddek, T., & Potes, M. E. (2019). The microbiology of food preservation. In *Food Microbiology* (4th ed, pp. 122–126). CPI Group (UK) Ltd. https://doi.org/10.1155/2019/8039138

Larsen, N., Vogensen, F. K., Van Den Berg, F. W. J., Nielsen, D. S., Andreasen, A. S., Pedersen, B. K., Al-Soud, W. A., Sørensen, S. J., Hansen, L. H., & Jakobsen, M. (2010). Gut microbiota in human adults with type 2 diabetes differs from non-diabetic adults. *PLoS ONE*, *5*(2). https://doi.org/10.1371/journal.pone.0009085

Lee, M., Lee, J., Nam, Y., Lee, J. S., Seo, M., & Yi, S. (2015). Characterization of antimicrobial lipopeptides produced by *Bacillus* sp. LM7 isolated from chungkookjang, a Korean traditional fermented soybean food. *International Journal of Food Microbiology*, *221*(March), 12–18. https://doi.org/10.1016/j.ijfoodmicro.2015.12.010

Leite, A. M. O., Miguel, M. A. L., Peixoto, R. S., Ruas-Madiedo, P., Paschoalin, V. M. F., Mayo, B., & Delgado, S. (2015). Probiotic potential of selected lactic acid bacteria strains isolated from Brazilian kefir grains. *Journal of Dairy Science*, *98*(6), 3622–3632. https://doi.org/10.3168/jds.2014-9265

Leonhardt, S. D., & Kaltenpoth, M. (2014). Microbial communities of three sympatric Australian stingless bee species. *PloS One*, *9*(8), 1–6. https://doi.org/10.1371/journal.pone.0105718

Li, Q., Liu, X., & Zhou, J. (2015). Aggregation and adhesion abilities of 18 lactic acid bacteria strains isolated from traditional fermented food. *International Journal of Agriculture Policy and Research*, *3*(February), 84–92. https://doi.org/10.1007/s00217-007-0632-x

Li, Y., Yao, J., Han, C., Yang, J., Chaudhry, M. T., Wang, S., Liu, H., & Yin, Y. (2016). Quercetin, inflammation and immunity. *Nutrients*, *8*(3), 1–14. https://doi.org/10.3390/nu8030167

Liong, M. T., & Shah, N. P. (2005). Acid and bile tolerance and cholesterol removal ability of *Lactobacilli* strains. *Journal of Dairy Science*, *88*(1), 55–66. https://doi.org/10.3168/jds.S0022-0302(05)72662-X

Lob, S., Afiffi, N., Razak, S. B. A., Ibrahim, N. F., & Mohd Nawi, I. H. (2017). Composition and identification of pollen collected by stingless bee (*Heterotrigona itama*) in forested and coastal area of Terengganu, Malaysia. *Malaysian Applied Biology*, *46*(3), 227–232. http://journalarticle.ukm.my/12379/

Lozo, J., Berić, T., Terzić-Vidojević, A., Stanković, S., Fira, D., & Stanisavljević, L. (2015). Microbiota associated with pollen, bee bread, larvae and adults of solitary bee *Osmia cornuta* (Hymenoptera: Megachilidae). *Bulletin of Entomological Research*, *105*(4), 470–476. https://doi.org/10.1017/S0007485315000292

Lozupone, C. A., Stombaugh, J. I., Gordon, J. I., Jansson, J. K., & Knight, R. (2012). Diversity, stability and resilience of the human gut microbiota. *Nature*, *489*(7415), 220–230. https://doi.org/10.1038/nature11550

Madureira, A. R., Pereira, C. I., Truszkowska, K., Gomes, A. M., Pintado, M. E., & Malcata, F. X. (2005). Survival of probiotic bacteria in a whey cheese vector submitted to environmental conditions prevailing in the gastrointestinal tract. *International Dairy Journal*, *15*(6–9), 921–927. https://doi.org/10.1016/j.idairyj.2004.08.025

Makete, G., Aiyegoro, O. A., & Thantsha, M. S. (2017). Isolation, identification and screening of potential probiotic bacteria in milk from South African Saanen goats. *Probiotics and Antimicrobial Proteins*, *9*(3), 246–254. https://doi.org/10.1007/s12602-016-9247-5

Malanicheva, I. A., Kozlov, D. G., Sumarukova, I. G., Efremenkova, O. V., Zenkova, V. A., Katrukha, G. S., Reznikova, M. I., Tarasova, O. D., Sineokii, S. P., & El'-Registan, G. I. (2012). Antimicrobial activity of *Bacillus megaterium* strains. *Microbiology*, *81*(2), 178–185. https://doi.org/10.1134/S0026261712020063

Malaysia Food act 1983. (2014). *FOOD ACT 1983 FOOD (AMENDMENT) (NO. 3) REGULATIONS 2014* (Issue June, pp. 5–6). https://doi.org/10.1038/132817a0

Malaysia Standards. (2017). *Kelulut (Stingless Bee) Honey – Specification MS 2683: 2017.*

Manap, M. Y. A. (2008). *Probiotics: Your Friendly Gut*. UPM Press.

Manning, R. (2001). Fatty acids in pollen: A review of their importance for honey bees. *Bee World*, *82*(2), 60–75. https://doi.org/10.1080/0005772X.2001.11099504

Maragkoudakis, P. A., Zoumpopoulou, G., Miaris, C., Kalantzopoulos, G., Pot, B., & Tsakalidou, E. (2006). Probiotic potential of *Lactobacillus* strains isolated from dairy products. *International Dairy Journal*, *16*(3), 189–199. https://doi.org/10.1016/j.idairyj.2005.02.009

Mărgăoan, R., Mărghitaş, L. Al, Dezmirean, D. S., Dulf, F. V., Bunea, A., Socaci, S. A., & Bobiş, O. (2014). Predominant and secondary pollen botanical origins influence the carotenoid and fatty acid profile in fresh honeybee-collected pollen. *Journal of Agricultural and Food Chemistry*, *62*(27), 6306–6316. https://doi.org/10.1021/jf5020318

Margaoan, R., Marghitas, L. A., Dezmirean, D., Mihai, C. M., & Bobis, O. (2010). Bee collected pollen – General aspects and chemical composition. *Bulletin UASVM Animal Science and Biotechnologies*, *67*(1–2), 254–259. https://doi.org/http://dx.doi.org/10.15835/buasvmcn-asb:67:1-2:5305

Markiewicz-Zukowska, R., Naliwajko, S. K., Bartosiuk, E., Moskwa, J., Isidorov, V., Soroczyńska, J., & Borawska, M. H. (2013). Chemical composition and antioxidant activity of beebread, and its influence on the glioblastoma cell line (U87MG). *Journal of Apicultural Science*, *57*(2), 147–157. https://doi.org/10.2478/jas-2013-0025

Matsumoto, M., Ohishi, H., & Benno, Y. (2004). H+-ATPase activity in *Bifidobacterium* with special reference to acid tolerance. *International Journal of Food Microbiology*, *93*(1), 109–113. https://doi.org/10.1016/j.ijfoodmicro.2003.10.009

Mattila, H. R., Rios, D., Walker-sperling, V. E., Roeselers, G., & Newton, I. L. G. (2012). Characterization of the active microbiotas associated with honey bees reveals healthier and broader communities when colonies are genetically diverse. *PloS One*, *7*(3), 1–11. https://doi.org/10.1371/journal.pone.0032962

Mauriello, G., De Prisco, A., Di Prisco, G., La Storia, A., & Caprio, E. (2017). Microbial characterization of bee pollen from the Vesuvius area collected by using three different traps. *PLoS ONE*, *12*(9), 1–17. https://doi.org/10.1371/journal.pone.0183208

McFrederick, Q. S., Wcislo, W. T., Taylor, D. R., Ishak, H. D., Dowd, S. E., & Mueller, U. G. (2012). Environment or kin: Whence do bees obtain acidophilic bacteria? *Molecular Ecology*, *21*(7), 1754–1768. https://doi.org/10.1111/j.1365-294X.2012.05496.x

Menezes, C., Vollet-neto, A., Andrés, F., León, F., Venturieri, G. C., & Imperatriz-fonseca, V. L. (2013). The role of useful microorganisms to stingless bees and stingless beekeeping. In *Pot-Honey: A Legacy of Stingless Bees* (pp. 153–171). https://doi.org/10.1007/978-1-4614-4960-7

Metchnikoff, I. I. (2004). *The prolongation of life- Optimistic studies*. Springer Publishing Company.

Michener, C. D. (2000). The bees of the world. In *The Johns Hopkins University Press* (Vol. 85, Issue 1). https://doi.org/10.1653/0015-4040(2002)085[0290:FMBLZH]2.0.CO;2

Mishra, V., & Prasad, D. N. (2005). Application of in vitro methods for selection of *Lactobacillus casei* strains as potential probiotics. *International Journal of Food Microbiology*, *103*(1), 109–115. https://doi.org/10.1016/j.ijfoodmicro.2004.10.047

Miwa, T., Esaki, H., Umemori, J., & Hino, T. (1997). Activity of H+-ATpase in ruminal bacteria with special reference to acid tolerance. *Applied and Environmental Microbiology*, *63*(6), 2155–2158. https://doi.org/10.1128/aem.63.6.2155-2158.1997

Mizrahi, A., & Lensky, Y. (2013). *Bee products: properties, applications, and apitherapy*. Springer Science & Business Media.

Mohd Adnan, A. F., & Tan, I. K. P. (2007). Isolation of lactic acid bacteria from Malaysian foods and assessment of the isolates for industrial potential. *Bioresource Technology*, *98*(7), 1380–1385. https://doi.org/10.1016/j.biortech.2006.05.034

Moniruzzaman, M., Chowdhury, M. A. Z., Rahman, M. A., Sulaiman, S. A., & Gan, S. H. (2014). Determination of mineral, trace element, and pesticide levels in honey samples originating from different regions of Malaysia compared to Manuka honey. *BioMed Research International*, *2014*(15052). https://doi.org/10.1155/2014/359890

Monteagudo-mera, A., Rodriguez-Aparicio, L., Rua, J., Martinez-Blanco, H., Navasa, N., Garcia-Armesto, M. R., & Ferrero, M. A. (2012). In vitro evaluation of physiological probiotic properties of different lactic acid bacteria strains of dairy and human origin. *Journal of Functional Foods*, *4*(2), 531–541. https://doi.org/10.1016/j.jff.2012.02.014

Moraes, P. M., Perin, L. M., Júnior, A. S., & Nero, L. A. (2013). Comparison of phenotypic and molecular tests to identify lactic acid bacteria. *Brazilian Journal of Microbiology*, *112*(2013), 109–112.

Morais, M., Moreira, L., Feás, X., & Estevinho, L. M. (2011). Honeybee-collected pollen from five Portuguese natural parks: Palynological origin, phenolic content, antioxidant properties and antimicrobial activity. *Food and Chemical Toxicology*, *49*(5), 1096–1101. https://doi.org/10.1016/j.fct.2011.01.020

Moran, N. A. (2015). Genomics of the honey bee microbiome. *Current Opinion in Insect Science*, *10*(August), 22–28. https://doi.org/10.1016/j.cois.2015.04.003

Morelli, L., & Capurso, L. (2012). FAO/WHO Guidelines on Probiotics: 10 Years Later. *Journal of Clinical Gastroenterology*, *46*(October), S1–S2. https://doi.org/10.1097/mcg.0b013e318269fdd5

Müller-Auffermann, K., Grijalva, F., Jacob, F., & Hutzler, M. (2015). Nisin and its usage in breweries: A review and discussion. *Journal of the Institute of Brewing*, *121*(3), 309–319. https://doi.org/10.1002/jib.233

Nagai, T., Nagashima, T., Myoda, T., & Inoue, R. (2004). Preparation and functional properties of extracts from bee bread. *Nahrung - Food*, *48*(3), 226–229. https://doi.org/10.1002/food.200300421

Narvhus, J. A., & Axelsson, L. (2003). Lactic acid bacteria. In *The Encyclopedia of Food Sciences and Nutrition* (2nd ed, pp. 3465–3472). Academic Press.

Nascimento, N. O., Nalini, H. A., Ataide, F., Abreu, A. T., & Antonini, Y. (2018). Pollen storage by stingless bees as an environmental marker for metal contamination: Spatial and temporal distribution of metal elements. *Sociobiology*, *65*(2), 259–270. https://doi.org/10.13102/sociobiology.v65i2.2078

Ngalimat, M. S., Rahman, R. N. Z. R. A., Yusof, M. T., Syahir, A., & Sabri, S. (2019). Characterisation of bacteria isolated from the stingless bee, *Heterotrigona itama*, honey, bee bread and propolis. *PeerJ*, *2019*(8), 1–20. https://doi.org/10.7717/peerj.7478

Nicolson, S. W., & Human, H. (2012). Chemical composition of the ' low quality ' pollen of sunflower (*Helianthus annuus* , *Asteraceae*). *Apidologie*, *44*(2), 144–152. https://doi.org/10.1007/s13592-012-0166-5

Nielsen, S. S. (2010). *Food Analysis* (4th ed). Springer US.

Nueno-Palop, C., & Narbad, A. (2011). Probiotic assessment of *Enterococcus faecalis* CP58 isolated from human gut. *International Journal of Food Microbiology*, *145*(2–3), 390–394. https://doi.org/10.1016/j.ijfoodmicro.2010.12.029

Nuhwa, R., Tanasupawat, S., Taweechotipatr, M., Sitdhipol, J., & Savarajara, A. (2019). Bile salt hydrolase activity and cholesterol assimilation of lactic acid bacteria isolated from flowers. *Journal of Applied Pharmaceutical Science*, *9*(6), 106–110. https://doi.org/10.7324/JAPS.2019.90615

O'Bryan, C. A., Crandall, P. G., Ricke, S. C., & Ndahetuye, J. B. (2015). Lactic acid bacteria (LAB) as antimicrobials in food products: Types and mechanisms of action. In *Handbook of Natural Antimicrobials for Food Safety and Quality*. Elsevier Ltd. https://doi.org/10.1016/B978-1-78242-034-7.00006-2

Oelschlaeger, T. A. (2010). Mechanisms of probiotic actions - A review. *International Journal of Medical Microbiology*, *300*(1), 57–62. https://doi.org/10.1016/j.ijmm.2009.08.005

Oliveira, K. C. L. S., Moriya, M., Azedo, R. A. B., & Almeida-Muradian, L. B. de. (2009). Relationship between botanical origin and antioxidants vitamins of bee-collected pollen. *Quimica Nova*, *32*(5), 1099–1102. https://doi.org/http://dx.doi.org/10.1590/S0100-40422009000500003

Olofsson, T. C., & Vásquez, A. (2008). Detection and identification of a novel lactic acid bacterial flora within the honey stomach of the honeybee *Apis mellifera*. *Current Microbiology*, *57*(4), 356–363. https://doi.org/10.1007/s00284-008-9202-0

Oltica, S., Mărghitaş, L. Al, & Dezmirean, D. (2007). Examination of antioxidant capacity of beebread extracts by different complementary assays. *Bulletin UASVM-CN*, *64*(1–2), 63–64. https://doi.org/10.15835/buasvmcn-asb:64:1-2:2247

Omar, W. A. W., Yahaya, N., Ghaffar, Z. A., & Fadzilah, N. H. (2018). GC-MS analysis of chemical constituents in ethanolic bee pollen extracts from three species of malaysian stingless bee. *Journal of Apicultural Science*, *62*(2), 275–284. https://doi.org/10.2478/JAS-2018-0022

Onti, I. C., Edrzycki, P. M., Rgenti, C. A., Eloni, M. M., Ecchione, V. V, & Oi, M. B. (2016). Sugar and protein content in different monofloral pollens - Building a database. *Bulletin of Insectology*, *69*(2), 318–320. https://pdfs.semanticscholar.org/b004/cf43887926ca648c839793edc74d67b004d1.pdf

Ouoba, L. I. I., Thorsen, L., & Varnam, A. H. (2008). Enterotoxins and emetic toxins production by *Bacillus cereus* and other species of *Bacillus* isolated from Soumbala and Bikalga, African alkaline fermented food condiments. *International Journal of Food Microbiology*, *124*(3), 224–230. https://doi.org/10.1016/j.ijfoodmicro.2008.03.026

Ouwehand, A. C., Saxelins, M., & Salminen, S. (2004). Phenotypic differences between commercial *Lactobacillus rhamnosus* GG and *L. rhamnosus* strains recovered from blood. *Clinical Infectious Diseases*, *39*(12), 1858–1860. https://doi.org/10.1086/425741

Ouwehand, Arthur C, Kirjavainen, P. V, Shortt, C., & Salminen, S. (1999). Probiotics : mechanisms and established effects. *International Dairy Journal*, *9*, 43–52.

Pacini, E., Guarnieri, M., & Nepi, M. (2006). Pollen carbohydrates and water content during development, presentation, and dispersal: A short review. *Protoplasma*, *228*(1–3), 73–77. https://doi.org/10.1007/s00709-006-0169-z

Palmer, C., Bik, E. M., Digiulio, D. B., Relman, D. A., & Brown, P. O. (2007). Development of the human infant intestinal microbiota. *PloS Biology*, *5*(7), e777. https://doi.org/10.1371/journal.pbio.0050177

Panghal, A., Janghu, S., Virkar, K., Gat, Y., Kumar, V., & Chhikara, N. (2018). Potential non-dairy probiotic products – A healthy approach. *Food Bioscience*, *21*, 80–89. https://doi.org/10.1016/j.fbio.2017.12.003

Papadimitriou, K., Alegría, Á., Bron, P. A., de Angelis, M., Gobbetti, M., Kleerebezem, M., Lemos, J. A., Linares, D. M., Ross, P., Stanton, C., Turroni, F., van Sinderen, D., Varmanen, P., Ventura, M., Zúñiga, M., Tsakalidou, E., & Kok, J. (2016). Stress physiology of lactic acid bacteria. *Microbiology and Molecular Biology Reviews*, *80*(3), 837–890. https://doi.org/10.1128/mmbr.00076-15

Papadimitriou, K., Zoumpopoulou, G., Foligné, B., Alexandraki, V., Kazou, M., Pot, B., & Tsakalidou, E. (2015). Discovering probiotic microorganisms: *In vitro*, *in vivo*, genetic and omics approaches. *Frontiers in Microbiology*, *6*(58), 1–28. https://doi.org/10.3389/fmicb.2015.00058

Pascoal, A., Rodrigues, S., Teixeira, A., Feás, X., & Leticia, M. (2014). Biological activities of commercial bee pollens: antimicrobial, antimutagenic, antioxidant and anti-inflammatory. *Food and Chemical Toxicology*, *63*(Jan), 233–269. https://doi.org/10.1016/j.fct.2013.11.010

Patel, A. K., Ahire, J. J., Pawar, S. P., Chaudhari, B. L., & Chincholkar, S. B. (2009). Comparative accounts of probiotic characteristics of *Bacillus* spp. isolated from food wastes. *Food Research International*, *42*(4), 505–510. https://doi.org/10.1016/j.foodres.2009.01.013

Pereira De Melo, I. L., & De Almeida-Muradian, L. B. (2010). Stability of antioxidants vitamins in bee pollen samples. *Quimica Nova*, *33*(3), 514–518. https://doi.org/10.1590/s0100-40422010000300004

Perez, K. J., Viana, J. dos S., Lopes, F. C., Pereira, J. Q., dos Santos, D. M., Oliveira, J. S., Velho, R. V., Crispim, S. M., Nicoli, J. R., Brandelli, A., & Nardi, R. M. D. (2017). *Bacillus* spp. isolated from puba as a source of biosurfactants and antimicrobial lipopeptides. *Frontiers in Microbiology*, *8*(JAN), 1–14. https://doi.org/10.3389/fmicb.2017.00061

Perez, R. H., Zendo, T., & Sonomoto, K. (2014). Novel bacteriocins from lactic acid bacteria (LAB): Various structures and applications. *Microbial Cell Factories*, *13*(Suppl 1), S3. https://doi.org/10.1186/1475-2859-13-S1-S3

Pianpumepong, P., & Noomhorm, A. (2010). Isolation of probiotic bacteria from turmeric (*Curcuma longa* Linn.) and its application in enriched beverages. *International Journal of Food Science & Technology*, *45*(12), 2456–2462. https://doi.org/10.1111/j.1365-2621.2010.02337.x

Pinto-Sanchez, M. I., Hall, G. B., Ghajar, K., Nardelli, A., Bolino, C., Lau, J. T., Martin, F. P., Cominetti, O., Welsh, C., Rieder, A., Traynor, J., Gregory, C., De Palma, G., Pigrau, M., Ford, A. C., Macri, J., Berger, B., Bergonzelli, G., Surette, M. G., … Bercik, P. (2017). Probiotic *Bifidobacterium longum* NCC3001 reduces depression scores and alters brain activity: A pilot study in patients with irritable bowel syndrome. *Gastroenterology*, *153*(2), 448-459.e8. https://doi.org/10.1053/j.gastro.2017.05.003

Pisano, M. B., Fadda, M. E., Deplano, M., Corda, A., & Cosentino, S. (2006). Microbiological and chemical characterization of Fiore Sardo, a traditional Sardinian cheese made from ewe's milk. *International Journal of Dairy Technology*, *59*(3), 171–179. https://doi.org/10.1111/j.1471-0307.2006.00260.x

Plessas, S., Nouska, C., Karapetsas, A., Kazakos, S., Alexopoulos, A., Mantzourani, I., Chondrou, P., Fournomiti, M., Galanis, A., & Bezirtzoglou, E. (2017). Isolation , characterization and evaluation of the probiotic potential of a novel *Lactobacillus* strain isolated from Feta-type cheese. *Food Chemistry*, *226*(July), 102–108. https://doi.org/10.1016/j.foodchem.2017.01.052

Powell, J. E., Martinson, V. G., Urban-Mead, K., & Moran, N. A. (2014). Routes of acquisition of the gut microbiota of the honey bee *Apis mellifera*. *Applied and Environmental Microbiology*, *80*(23), 7378–7387. https://doi.org/10.1128/AEM.01861-14

PR Newswire. (2019). The global functional foods market size is projected to reach USD 275.77 billion by 2025. *PRNewswire*, 1.

Prasad, J., Gill, H., Smart, J., & Gopal, P. K. (2000). Selection and Characterisation of *Lactobacillus* and *Bifidobacterium* strains for use as probiotics. *International Dairy Journal*, *6946*(99), 993–1002. https://doi.org/10.1016/S0958-6946(99)00024-2

Pruccoli, G., Silvestro, E., Napoleone, C. P., Aidala, E., Garazzino, S., & Scolfaro, C. (2019). Are probiotics safe? *Bifidobacterium* bacteremia in a child with severe heart failure. *Infezioni in Medicina*, *27*(2), 175–178. https://pubmed.ncbi.nlm.nih.gov/31205041/

Qin, J., Li, R., Raes, J., Arumugam, M., Burgdorf, K. S., Manichanh, C., Nielsen, T., Pons, N., Levenez, F., Yamada, T., Mende, D. R., Li, J., Xu, J., Li, S., Li, D., Cao, J., Wang, B., Liang, H., Zheng, H., … Wang, J. (2010). A human gut microbial gene catalogue established by metagenomic sequencing. *Nature*, *464*(7285), 59–65. https://doi.org/10.1038/nature08821

Ramachandran, R., Chalasani, A. G., Lal, R., & Roy, U. (2014). A broad-spectrum antimicrobial activity of *Bacillus subtilis* RLID 12.1. *Scientific World Journal*, *2014*. https://doi.org/10.1155/2014/968487

Ramalho, M, L, V., & Giannini, T. C. (1998). Within-colony size variation of foragers and pollen load capacity in the stingless bee *Melipona quadrifasciata* anthidioides Lepeletier (Apidae , Hymenoptera) b. *Apidologie*, *29*(3), 221–228. https://doi.org/10.1051/apido:19980302

Ramalho, Mauro, Giannini, T. C., Malagodi-braga, K. S., Vera, L., Imperatriz-fonseca, V. L., & Pollen, V. L. (2009). Pollen harvest by stingless bee foragers pollen harvest by stingless bee foragers (Hymenoptera) ,. *Grana*, *33*(4), 239–244. https://doi.org/10.1080/00173139409429005

Ramasamy, K., Rahman, N. Z. A., Chin, S. C., Alitheen, N. J., Abdullah, N., & Wan, H. Y. (2012). Probiotic potential of lactic acid bacteria from fermented Malaysian food or milk products. *International Journal of Food Science and Technology*, *47*(10), 2175–2183. https://doi.org/10.1111/j.1365-2621.2012.03085.x

Ramos, H. C., Hoffmann, T., Marino, M., Nedjari, H., Presecan-Siedel, E., Dreesen, O., Glaser, P., & Jahn, D. (2000). Fermentative metabolism of *Bacillus subtilis*: Physiology and regulation of gene expression. *Journal of Bacteriology*, *182*(11), 3072–3080. https://doi.org/10.1128/JB.182.11.3072-3080.2000

Ramos, O. Y., Basualdo, M., Libonatti, C., & Vega, M. F. (2019). Current status and application of lactic acid bacteria in animal production systems with a focus on bacteria from honey bee colonies. *Journal of Applied Microbiology*, 1–13. https://doi.org/10.1111/jam.14469

Razmpoosh, E., Javadi, A., Ejtahed, H. S., Mirmiran, P., Javadi, M., & Yousefinejad, A. (2019). The effect of probiotic supplementation on glycemic control and lipid profile in patients with type 2 diabetes: A randomized placebo controlled trial. *Diabetes and Metabolic Syndrome: Clinical Research and Reviews*, *13*(1), 175–182. https://doi.org/10.1016/j.dsx.2018.08.008

Rebelo, K. S., Ferreira, A. G., & Carvalho-Zilse, G. A. (2016). Physicochemical characteristics of pollen collected by Amazonian stingless bees. *Ciência Rural*, *46*(5), 927–932. https://doi.org/10.1590/0103-8478cr20150999

Reuter, S., Gupta, S. C., Chaturvedi, M. M., & Aggarwal, B. B. (2011). Oxidative stress, inflammation, and cancer. *Free Radic Biol Med.*, *49*(11), 1603–1616. https://doi.org/10.1016/j.freeradbiomed.2010.09.006.Oxidative

Rezai, G., Teng, P. K., Mohamed, Z., & Shamsudin, M. N. (2012). Functional food knowledge and perceptions among young consumers in Malaysia. *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering*, *6*(3), 7–12.

Rivière, A., Selak, M., Lantin, D., Leroy, F., & De Vuyst, L. (2016). *Bifidobacteria* and butyrate-producing colon bacteria: Importance and strategies for their stimulation in the human gut. *Frontiers in Microbiology*, *7*(JUN). https://doi.org/10.3389/fmicb.2016.00979

Rodríguez, L. G. R., Mohamed, F., Bleckwedel, J., Medina, R., Vuyst, L. De, Hebert, E. M., & Mozzi, F. (2019). Diversity and functional properties of lactic acid bacteria isolated from wild fruits and flowers present in Northern Argentina. *Frontiers in Microbiology*, *10*(May), 1–26. https://doi.org/10.3389/fmicb.2019.01091

Rokop, Z. P., Horton, M. A., & Newton, I. L. G. (2015). Interactions between cooccurring lactic acid bacteria in honey. *Journal ASM*, *81*(20), 7261–7270. https://doi.org/10.1128/AEM.01259-15

Roman, A. (2009). Concentration of chosen trace elements of toxic properties in bee pollen loads. *Polish Journal of Environmental Studies*, *18*(2), 265–272.

Roman, A., Popiela-Pleban, E., Migdał, P., & Kruszyński, W. (2016). As, Cr, Cd, and Pb in bee Products from a Polish industrialized region. *Open Chemistry*, *14*(1), 33–36. https://doi.org/10.1515/chem-2016-0007

Rosa, C. A., Lachance, M. A., Silva, J. O. C., Teixeira, A. C. P., Marini, M. M., Antonini, Y., & Martins, R. P. (2003). Yeast communities associated with stingless bees. *FEMS Yeast Research*, *4*(3), 271–275. https://doi.org/10.1016/S1567-1356(03)00173-9

Roulston, T. H. I., & Cane, J. H. (2000). Pollen nutritional content and digestibility for animals. *Plant Systematics and Evolution*, *222*(1–4), 187–188. https://doi.org/https://doi.org/10.1007/BF00984102

Ruiz, L., Margolles, A., & Sánchez, B. (2013). Bile resistance mechanisms in *Lactobacillus* and *Bifidobacterium*. *Frontiers in Microbiology*, *4*(396), 1–8. https://doi.org/10.3389/fmicb.2013.00396

Sakai, T., Makino, H., Ishikawa, E., Oishi, K., & Kushiro, A. (2011). Fermented milk containing *Lactobacillus casei* strain Shirota reduces incidence of hard or lumpy stools in healthy population. *International Journal of Food Sciences and Nutrition*, *62*(4), 423–430. https://doi.org/10.3109/09637486.2010.542408

Sakandar, H. A., Kubow, S., & Sadiq, F. A. (2019). Isolation and *in-vitro* probiotic characterization of fructophilic lactic acid bacteria from Chinese fruits and flowers. *Lwt*, *104*, 70–75. https://doi.org/10.1016/j.lwt.2019.01.038

Salleh, Hayatul Safrah; Mohd Noor, Nor Azila; Nik Mat, Nik Hamizah; Yusof, Yusnita; Mohamed, W. N. (2015). *The consumption of functional food in Malaysia : Their profiles and behaviours*. *14*(4), 725–734.

Salminen, S., & Forum, F. F. (2016). Probiotics: Application of probiotics in dairy products: established and potential benefits. In *Reference Module in Food Science* (pp. 412–419). Elsevier. https://doi.org/10.1016/B978-0-08-100596-5.00634-X

Sanders, M. E. (2008). Probiotics: Definition, sources, selection, and uses. *Clinical Infectious Diseases*, *46*, 58–61. https://doi.org/10.1086/523341

Santos, P. H. S., & Silva, M. A. (2008). Retention of vitamin C in drying processes of fruits and vegetables - A review. *Drying Technology*, *26*(12), 1421–1437. https://doi.org/10.1080/07373930802458911

Sattler, J. A. G., de Melo, I. L. P., Granato, D., Araújo, E., da Silva de Freitas, A., Barth, O. M., Sattler, A., & de Almeida-Muradian, L. B. (2015). Impact of origin on bioactive compounds and nutritional composition of bee pollen from southern Brazil: A screening study. *Food Research International*, *77*, 82–91. https://doi.org/10.1016/j.foodres.2015.09.013

Schillinger, U., Guigas, C., & Holzapfel, W. H. (2005). *In vitro* adherence and other properties of lactobacilli used in probiotic yoghurt-like products. *International Dairy Journal*, *15*(12), 1289–1297. https://doi.org/10.1016/j.idairyj.2004.12.008

Shah, N P. (2000). Probiotic bacteria : Selective enumeration and survival in dairy foods. *Journal of Dairy Science*, *83*(4), 894–907. https://doi.org/10.3168/jds.S0022-0302(00)74953-8

Shah, Nagendra P. (2007). Functional cultures and health benefits. *International Dairy Journal*, *17*(11), 1262–1277. https://doi.org/10.1016/j.idairyj.2007.01.014

Sharafi, H., & Derakhshan, V. (2014). *Lactobacillus crustorum* KH : Novel prospective probiotic strain isolated from Iranian traditional dairy products. *Applied Biochemistry and Biotechnology*, *175*(4), 2178–2194. https://doi.org/10.1007/s12010-014-1404-2

Sharma, G., Dang, S., Gupta, S., & Gabrani, R. (2018). Antibacterial activity, cytotoxicity, and the mechanism of action of bacteriocin from *Bacillus subtilis* GAS101. *Medical Principles and Practice*, *27*(2), 186–192. https://doi.org/10.1159/000487306

Sharma, P., Tomar, S. K., Sangwan, V., Goswami, P., & Singh, R. (2016). Antibiotic resistance of *Lactobacillus* sp. isolated from commercial probiotic preparations. *Journal of Food Safety*, *36*(1), 38–51. https://doi.org/10.1111/jfs.12211

Shbib, S. A., & Soukkarieh, C. (2015). The accuracy of API 20E and PCR using 16s rRNA gene for characterization of *Escherichia coli* strains causing urinary tract infections in Damascus-Syria. *International Journal of PharmTech Research*, *8*(4), 741–749. http://sphinxsai.com/2015/ph_vol8_no4/2/(741-749)V8N4PT.pdf

Shehata, M. G., El Sohaimy, S. A., El-Sahn, M. A., & Youssef, M. M. (2016). Screening of isolated potential probiotic lactic acid bacteria for cholesterol lowering property and bile salt hydrolase activity. *Annals of Agricultural Sciences*, *61*(1), 65–75. https://doi.org/10.1016/j.aoas.2016.03.001

Shewale, R. N., Sawale, P. D., Khedkar, C. D., & Singh, A. (2014). Selection criteria for probiotics: A review. *International Journal of Probiotics and Prebiotics*, *9*(1), 17–22.

Shi, F., Wang, Y., Li, Y., & Wang, X. (2016). Mode of action of leucocin K7 produced by *Leuconostoc mesenteroides* K7 against *Listeria monocytogenes* and its potential in milk preservation. *Biotechnology Letters*, *38*(9), 1551–1557. https://doi.org/10.1007/s10529-016-2127-y

Shokryazdan, P., Jahromi, M. F., Liang, J. B., Wan, Y., Shokryazdan, P., Faseleh, M., Boo, J., & Wan, Y. (2017). Probiotics : From isolation to application probiotics. *Journal of the American College of Nutrition*, *36*(8), 666–676. https://doi.org/10.1080/07315724.2017.1337529

Silva-Dias, A., Miranda, I. M., Branco, J., Monteiro-Soares, M., Pina-Vaz, C., & Rodrigues, A. G. (2015). Adhesion, biofilm formation, cell surface hydrophobicity, and antifungal planktonic susceptibility: Relationship among *Candida* spp. *Frontiers in Microbiology*, *6*(MAR). https://doi.org/10.3389/fmicb.2015.00205

Silva, T. M. S., Camara, C. A., Lins, A. C. S., Agra, M. de F., Silva, E. M. S., Reis, I. T., & Freitas, B. M. (2009). Chemical composition, botanical evaluation and screening of radical scavenging activity of collected pollen by the stingless bees *Melipona rufiventris* (Uruçu-amarela). *Anais Da Academia Brasileira de Ciencias*, *81*(2), 173–178. https://doi.org/10.1590/s0001-37652009000200003

Singh, R. S., Singh, R. P., & Yadav, M. (2013). Molecular and biochemical characterization of a new endoinulinase producing bacterial strain of *Bacillus safensis* AS-08. *Biologia (Poland)*, *68*(6), 1028–1033. https://doi.org/10.2478/s11756-013-0259-2

Singh, T. P., Malik, R. K., & Kaur, G. (2016). Cell surface proteins play an important role in probiotic activities of *Lactobacillus reuteri*. *Nutrire*, *41*(1), 1–10. https://doi.org/10.1186/s41110-016-0007-9

Slykerman, R. F., Hood, F., Wickens, K., Thompson, J. M. D., Barthow, C., Murphy, R., Kang, J., & Rowden, J. (2017). Effect of *Lactobacillus rhamnosus* HN001 in pregnancy on postpartum symptoms of depression and anxiety : A randomised double-blind placebo-controlled trial. *EBioMedicine*, *24*(October), 159–165. https://doi.org/10.1016/j.ebiom.2017.09.013

Smith, J. P., Heard, T. A., Beekman, M., & Gloag, R. (2016). Flight range of the Australian stingless bee *Tetragonula carbonaria* (Hymenoptera : Apidae). *Austral Entomology*, *56*(1), 50–53. https://doi.org/10.1111/aen.12206

Sobral, F., Calhelha, R. C., Barros, L., Duenas, M., Tomás, A., Santos-buelga, C., Vilas-boas, M., & Ferreira, I. C. F. R. (2017). Flavonoid composition and antitumor activity of bee bee bread collected in Northeast Portugal. *Molecule*, *22*(2), 248. https://doi.org/10.3390/molecules22020248

Socha, P. (2015). *The book of bees*. Thomas and Hudson.

Soetan, K. O., Olaiya, C. O., & Oyewole, O. E. (2010). The importance of mineral elements for humans , domestic animals and plants : A review. *African Journal of Food Science*, *4*(May), 200–222.

Somerville, D. C., & Nicol, H. I. (2002). Mineral content of honeybee-collected pollen from southern New South Wales. *Australian Journal of Experimental Agriculture*, *42*(8), 1131–1136. https://doi.org/10.1071/EA01086

Sornplang, P., & Piyadeatsoontorn, S. (2016). Probiotic isolates from unconventional sources: a review. *Journal of Animal Science and Technology*, *58*(1), 26. https://doi.org/10.1186/s40781-016-0108-2

Stanciu, O. G., Marghitas, L. A., & Dezmirean, D. (2009). Macro- and oligo-mineral elements from honeybee-collected pollen and beebread harvested from Transylvania (Romania). *Bulletin UASVM Animal Science and Biotechnologies*, *66*(1–2), 276–281. https://doi.org/10.15835/buasvmcn-asb:66:1-2:3368

Sullivan, Å., & Nord, C. E. (2006). Probiotic *Lactobacilli* and bacteraemia in Stockholm. *Scandinavian Journal of Infectious Diseases*, *38*(5), 327–331. https://doi.org/10.1080/00365540500449826

Sumi, C. D., Yang, B. W., Yeo, I. C., & Hahm, Y. T. (2015). Antimicrobial peptides of the genus *Bacillus*: A new era for antibiotics. *Canadian Journal of Microbiology*, *61*(2), 93–103. https://doi.org/10.1139/cjm-2014-0613

Šušković, J., Kos, B., Beganović, J., Pavunc, A. L., Habjanič, K., & Matoć, S. (2010). Antimicrobial activity - The most important property of probiotic and starter lactic acid bacteria. *Food Technology and Biotechnology*, *48*(3), 296–307.

Swain, M. R., Anandharaj, M., Ray, R. C., & Parveen Rani, R. (2014). Fermented Fruits and Vegetables of Asia: A Potential Source of Probiotics. *Biotechnology Research International*, *2014*, 1–19. https://doi.org/10.1155/2014/250424

Syed Yaacob, S. N., Huyop, F., Kamarulzaman Raja Ibrahim, R., & Wahab, R. A. (2018). Identification of *Lactobacillus* spp. and *Fructobacillus* spp. isolated from fresh *Heterotrigona itama* honey and their antagonistic activities against clinical pathogenic bacteria. *Journal of Apicultural Research*, *57*(3), 395–405. https://doi.org/10.1080/00218839.2018.1428047

Syngai, G. G., Gopi, R., Bharali, R., Dey, S., Lakshmanan, G. M. A., & Ahmed, G. (2016). Probiotics - the versatile functional food ingredients. *Journal of Food Science and Technology*, *53*(2), 921–933. https://doi.org/10.1007/s13197-015-2011-0

Szczęsna, T. (2006). Protein content and amino acid composition of bee-collected pollen from selected botanical origins. *Journal of Apicultural Science*, *50*(2), 81–90. https://pdfs.semanticscholar.org/174e/607b440f9acadc3c32eefef68b179d0630d8.pdf

Taha, E.-K. A., Al-Jabr, A. M., & Al-Kahtani, S. N. (2017). Honey bees, bee-collected pollen and honey as monitors of environmental pollution at an industrial cement area in Saudi Arabia. *Journal of the Kansas Entomological Society*, *90*(1), 1–10. https://doi.org/10.2317/151230.1

Tajabadi, N., Mardan, M., Manap, M. Y. A., & Mustafa, S. (2013). Molecular identification of *Lactobacillus* spp. isolated from the honey comb of the honey bee (*Apis dorsata*) by 16S rRNA gene sequencing. *Journal of Apicultural Research*, *52*(5), 235–241. https://doi.org/10.3896/IBRA.1.52.5.10

Takada, M., Nishida, K., Kataoka-Kato, A., Gondo, Y., Ishikawa, H., Suda, K., Kawai, M., Hoshi, R., Watanabe, O., Igarashi, T., Kuwano, Y., Miyazaki, K., & Rokutan, K. (2016). Probiotic *Lactobacillus casei* strain Shirota relieves stress-associated symptoms by modulating the gut–brain interaction in human and animal models. *Neurogastroenterology and Motility*, *28*(7), 1027–1036. https://doi.org/10.1111/nmo.12804

Tavdidishvili, D., Khutsidze, T., Pkhakadze, M., Vanidze, M., & Kalandia, A. (2014). Flavonoids in Georgian bee bread and bee pollen. *Jounal of Chemistry and Chemical Engineering*, *8*(7), 676–681. http://arabbeeresearchers.net/wp-content/uploads/2017/08/Flavonoids-in-Georgian-Bee-Bread-and-Bee-Pollen.pdf

Tchounwou, P. B., Yedjou, C. G., Patlolla, A. K., & Sutton, D. J. (2014). Heavy Metals toxicity and the environment. In *Molecular, clinical and environmental toxicology* (pp. 133–164). Springer. https://doi.org/10.1007/978-3-7643-8340-4

Teixeira, A. C. P., Marini, M. M., Nicoli, J. R., Antonini, Y., Martins, R. P., Lachance, M. A., & Rosa, C. A. (2003). *Starmerella meliponinorum* sp. nov., a novel ascomycetous yeast species associated with stingless bees. *International Journal of Systematic and Evolutionary Microbiology*, *53*(1), 339–343. https://doi.org/10.1099/ijs.0.02262-0

Temizer, İ. K., Güder, A., Temel, F. A., & Avci, E. (2018). A comparison of the antioxidant activities and biomonitoring of heavy metals by pollen in the urban environments. *Environmental Monitoring and Assessment*, *190*(8). https://doi.org/10.1007/s10661-018-6829-6

Temmerman, R., Huys, G., & Swings, J. (2004). Identification of lactic acid bacteria: Culture-dependent and culture-independent methods. *Trends in Food Science and Technology*, *15*(7–8), 348–359. https://doi.org/10.1016/j.tifs.2003.12.007

Thakodee, T., Deowanish, S., & Duangmal, K. (2018). Melissopalynological analysis of stingless bee (*Tetragonula pagdeni*) honey in Eastern Thailand. *Journal of Asia-Pacific Entomology*, *21*(2), 620–630. https://doi.org/10.1016/j.aspen.2018.04.003

The Star. (2016, September). Sweet profit in stingless bee farms. *The Star*.

Thompson, J. D., Gibson, T. J., & Higgins, D. G. (2003). Multiple Sequence Alignment using ClustalW and ClustalX. *Current Protocols in Bioinformatics*, *00*(1), 2.3.1-2.3.22. https://doi.org/10.1002/0471250953.bi0203s00

Tilley, L., Keppens, K., Kushiro, A., Takada, T., Sakai, T., Vaneechoutte, M., & Degeest, B. (2014). A probiotic fermented milk drink containing *Lactobacillus casei* strain shirota improves stool consistency of subjects with hard stools. *International Journal of Probiotics and Prebiotics*, *9*(1–2), 23–30.

Tokatl, M., Gülgör, G. G., Elmaci, S. B., Isleyen, N. A., & Özçelik, F. (2015). *In vitro* properties of potential probiotic indigenous lactic acid bacteria originating from traditional pickles. *BioMed Research International*, *2015*, 1–8. https://doi.org/http://dx.doi.org/10.1155/2015/315819

Tomás, A., Falcão, S. I., Russo-almeida, P., Vilas-boas, M., Tomás, A., Falcão, S. I., Russo-almeida, P., Vilas-boas, M., & Toma, A. (2017). Potentialities of beebread as a food supplement and source of nutraceuticals : Botanical origin , nutritional composition and antioxidant activity. *Journal of Apicultural Research*, *56*(3), 219–230. https://doi.org/10.1080/00218839.2017.1294526

Tonucci, L. B., Olbrich dos Santos, K. M., Licursi de Oliveira, L., Rocha Ribeiro, S. M., & Duarte Martino, H. S. (2017). Clinical application of probiotics in type 2 diabetes mellitus: A randomized, double-blind, placebo-controlled study. *Clinical Nutrition*, *36*(1), 85–92. https://doi.org/10.1016/j.clnu.2015.11.011

Touret, T., Oliveira, M., & Semedo-Lemsaddek, T. (2018). Putative probiotic lactic acid bacteria isolated from sauerkraut fermentations. *PLoS ONE*, *13*(9), 1–16. https://doi.org/10.1371/journal.pone.0203501

Tuo, Y., Zhang, W., Zhang, L., Ai, L., Zhang, Y., & Han, X. (2013). Study of probiotic potential of four wild *Lactobacillus rhamnosus* strains. *Anaerobe*, *21*(2013), 22–27. https://doi.org/10.1016/j.anaerobe.2013.03.007

Urcan, A. C., Criste, A. D., Dezmirean, D. S., Mărgăoan, R., Caeiro, A., & Campos, M. G. (2018). Similarity of data from bee bread with the same taxa collected in India and Romania. *Molecules*, *23*(10). https://doi.org/10.3390/molecules23102491

Urcan, A., Mărghitaș, L. Al, Dezmirean, D. S., Bobiș, O., Bonta, V., Mureșan, C. I., & Mărgăoan, R. (2017). Chemical composition and biological activities of beebread – Review. *Bulletin of the University of Agricultural Sciences & Veterinary Medicine Cluj-Napoca. Animal Science & Biotechnologies*, *74*(1), 1–9. https://doi.org/10.15835/buasvmcn-asb

Urdaci, M. C., & Pinchuk, I. V. (2004). Antimicrobial activity of *Bacillus* probiotics. In *Bacterial spore formers – Probiotics and emerging applications* (pp. 1–12). Horizon Bioscience.

Vásquez, A., Forsgren, E., Fries, I., Paxton, R. J., Flaberg, E., Szekely, L., & Olofsson, T. C. (2012). Symbionts as major modulators of insect health: Lactic acid bacteria and honeybees. *PLoS ONE*, *7*(3). https://doi.org/10.1371/journal.pone.0033188

Vásquez, A., & Olofsson, T. C. (2009). The lactic acid bacteria involved in the production of bee pollen and bee bread. *Journal of Apicultural Research*, *48*(3), 189–195. https://doi.org/10.3896/IBRA.1.48.3.07

Vásquez, A., & Olofsson, T. C. (2015). The lactic acid bacteria involved in the production of bee pollen and bee bread. *Journal of Apicultural Research*, *48*(3), 37–41. https://doi.org/10.3896/IBRA.1.48.3.07

Vergari, F., Tibuzzi, A., & Basile, G. (2010). An overview of the functional food market: From marketing issues and commercial players to future demand from life in space. *Advances in Experimental Medicine and Biology*, *698*, 308–321. https://doi.org/10.1007/978-1-4419-7347-4_23

Verna, E. C., & Lucak, S. (2010). Use of probiotics in gastrointestinal disorders : what to recommend? *Therapeutic Advances in Gastroenterology*, *3*(5), 307–319. https://doi.org/10.1177/1756283X10373814

Vesterlund, S., Vankerckhoven, V., Saxelin, M., Goossens, H., Salminen, S., & Ouwehand, A. C. (2007). Safety assessment of Lactobacillus strains: Presence of putative risk factors in faecal, blood and probiotic isolates. *International Journal of Food Microbiology*, *116*(3), 325–331. https://doi.org/10.1016/j.ijfoodmicro.2007.02.002

Vinderola, G., Gueimonde, M., Gomez-gallego, C., Defederico, L., & Salminen, S. (2017). Correlation between *in vitro* and *in vivo* assays in selection of probiotics from traditional species of bacteria. *Trends in Food Science & Technology*, *68*(October), 83–90. https://doi.org/10.1016/j.tifs.2017.08.005

Visiello, R., Colombo, S., & Carretto, E. (2016). *Bacillus cereus* Hemolysins and other virulence factors. In *The Diverse Faces of Bacillus cereus*. Elsevier Inc. https://doi.org/10.1016/b978-0-12-801474-5.00003-7

Vit, P., Albore, G. R. D., Barth, O. M., Peña-vera, M., & Pérez-pérez, E. (2018). Characterization of pot-pollen from Southern Venezuela. In *Pot-Pollen in Stingless Bee Melittology* (pp. 361–375). https://doi.org/10.1007/978-3-319-61839-5

Vit, P., Pedro, S. R. M., & Roubik, D. W. (2018). Pot-pollen in stingless bee melittology. *Pot-Pollen in Stingless Bee Melittology*, *2008*, 1–481. https://doi.org/10.1007/978-3-319-61839-5

Vit, P., & Pulcini, P. (1996). Diastase and invertase activities in Meliponini and Trigonini honeys from Venezuela. *Journal of Apicultural Research*, *35*(2), 57–62. https://doi.org/10.1080/00218839.1996.11100913

Vit, P., Roubik, D. W., & Pedro, S. R. M. (2012). The role of useful microorganisms to stingless bees and stingless beekeeping. In *Pot-Honey: A Legacy of Stingless Bees* (pp. 1–654). Springer Science & Business Media. https://doi.org/10.1007/978-1-4614-4960-7

Vit, P., Santiago, B., Peña-vera, M., & Pérez-pérez, E. (2018). Chemical characterization and bioactivity of *Tetragonisca angustula* pot-pollen from Mérida, Venezuela. In *Pot-Pollen in Stingless Bee Melittology* (pp. 339–347). https://doi.org/10.1007/978-3-319-61839-5

Vollet-Neto, A., Maia-Silva, C., Menezes, C., & Imperatriz-Fonseca, V. L. (2017). Newly emerged workers of the stingless bee *Scaptotrigona* aff. *depilis* prefer stored pollen to fresh pollen. *Apidologie*, *48*(2), 204–210. https://doi.org/10.1007/s13592-016-0464-4

Wagner, A., Duarte, F., Raphaella, M., Oda-souza, M., Oliveira, F. F. De, Maria, A., & López, Q. (2018). Honey and bee pollen produced by Meliponini (Apidae) in Alagoas , Brazil : multivariate analysis of physicochemical and antioxidant profiles. *Food Science and Biotechnolgy*, *2061*(3), 493–503. https://doi.org/10.1590/fst.09317

Wallace, C. J. K., & Milev, R. (2017). The effects of probiotics on depressive symptoms in humans: A systematic review. *Annals of General Psychiatry*, *16*(1), 1–10. https://doi.org/10.1186/s12991-017-0138-2

Wang, M., Zhao, W., Xu, H., Wang, Z., & He, S. (2015). *Bacillus* in the guts of honey bees (*Apis mellifera* ; Hymenoptera : Apidae) mediate changes in amylase values. *European Journal of Entomology*, *112*(4), 619–624. https://doi.org/10.14411/eje.2015.095

Wassenaar, T. M., & Klein, G. (2008). Safety aspects and implications of regulation of probiotic bacteria in food and food supplements. *Journal of Food Protection*, *71*(8), 1734–1741. https://doi.org/10.4315/0362-028X-71.8.1734

Wiele, T. Van De, Abbeele, P. Van Den, Ossieur, W., Possemiers, S., & Marzorati, M. (2016). The Simulator of the Human Intestinal Microbial Ecosystem (SHIME ®). In *The Impact of Food Bioactives on Health* (pp. 305–317). https://doi.org/10.1007/978-3-319-16104-4

Wook, K., Min, J., Park, S., Heo, H., Kim, H., Ham, K., & Hwan, J. (2016). Isolation of lactic acid bacteria with probiotic potentials from kimchi , traditional Korean fermented vegetable. *LWT - Food Science and Technology*, *71*, 130–137. https://doi.org/10.1016/j.lwt.2016.03.029

Xu, H., Jeong, H. S., Lee, H. Y., & Ahn, J. (2009). Assessment of cell surface properties and adhesion potential of selected probiotic strains. *Letters in Applied Microbiology*, *49*(4), 434–442. https://doi.org/10.1111/j.1472-765X.2009.02684.x

Yang, Z. (1997). Paml: A program package for phylogenetic analysis by maximum likelihood. *Bioinformatics*, *13*(5), 555–556. https://doi.org/10.1093/bioinformatics/13.5.555

Yi, L., Dang, Y., Wu, J., Zhang, L., Liu, X., Liu, B., Zhou, Y., & Lu, X. (2016). Purification and characterization of a novel bacteriocin produced by *Lactobacillus crustorum* MN047 isolated from koumiss from Xinjiang, China. *Journal of Dairy Science*, *99*(9), 7002–7015. https://doi.org/10.3168/jds.2016-11166

Yu, Z., Zhang, X., Li, S., Li, C., Li, D., & Yang, Z. (2013). Evaluation of probiotic properties of *Lactobacillus plantarum* strains isolated from Chinese sauerkraut. *World Journal of Microbiology and Biotechnology*, *29*(3), 489–498. https://doi.org/10.1007/s11274-012-1202-3

Zahir, F., Rizwi, S. J., Haq, S. K., & Khan, R. H. (2005). Low dose mercury toxicity and human health. *Environmental Toxicology and Pharmacology*, *20*(2), 351–360. https://doi.org/10.1016/j.etap.2005.03.007

Zaki, N. N. M., & Abd Razak, S. B. (2018). Pollen profile by stingless bee (*Heterotrigona itama*) reared in rubber smallholding environment at Tepoh , Terengganu. *Malaysian Journal of Microscopy*, *14*(1), 38–54. https://www.malaysianjournalofmicroscopy.org/ojs/index.php/mjm/article/view/46

Zhang, S., Oh, H.-H., Alexander, La. M., Ozcam, M., & Pijkeren, J.-P. van. (2018). D-Alanyl-D-Alanine Ligase as a broad-host-range counterselection marker in vancomycin-resistant lactic acid bacteria. *Journal of Bacteriology*, *200*(13), 1–15. https://doi.org/10.1128/JB.00607-17

Zheng, H., Nishida, A., Kwong, W. K., Koch, H., Engel, P., Steele, M. I., & Moran, N. A. (2016). Metabolism of toxic sugars by strains of the bee gut symbiont *Gilliamella apicola*. *MBio*, *7*(6), 1–9. https://doi.org/10.1128/mBio.01326-16

Zhu, H., Hart, C. A., Sales, D., & Roberts, N. B. (2006). Bacterial killing in gastric juice - Effect of pH and pepsin on *Escherichia coli* and *Helicobacter pylori*. *Journal of Medical Microbiology*, *55*(9), 1265–1270. https://doi.org/10.1099/jmm.0.46611-0

Zielińska, D., Oldak, A., Rzepkowska, A., & Zieliński, K. (2018). Enumeration and identification of probiotic bacteria in food matrices. *Advances in Biotechnology for Food Industry*, *14*, 167–196. https://doi.org/10.1016/B978-0-12-811443-8.00006-2

Ziemer, C. J., & Gibson, G. R. (1998). An overview of probiotics, prebiotics and synbiotics in the functional food concept: Perspectives and future strategies. *International Dairy Journal*, *8*(5–6), 473–479. https://doi.org/10.1016/S0958-6946(98)00071-5

Zubaidah, A. H., Shamsul Bahri, A. R., Sanusi, J., Adam, N. A., Azura, A., & Hamzah, A. H. (2018). Application of scanning electron microscope in palynology study of floral resources by indo-malayan stingless bees genus tetragonula. *Malaysian Journal of Microscopy*, *14*(1), 95–102.

Zuluaga, C. M., Serrato, J. C., & Quicazan, M. C. (2015). Chemical, nutritional and bioactive characterization of Colombian bee-bread. *Chemical Engineering Transactions*, *43*, 175–180. https://doi.org/10.3303/CET1543030