

Plants for Space:

Recipes

*For the modern
space cook*



Plants for Space: Recipes for the modern space cook

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Cover artwork by
Glenda Borchard and graphics by David Hughes



Plants for Space gratefully acknowledges Sunshine Coast, Queensland artist Glenda Borchard for creating the vibrant cover artwork for this cookbook. Inspired by the optimism and bold graphic style of the space age, Glenda's distinctive retro aesthetic captures the curiosity, creativity and imagination at the heart of Plants for Space. An accomplished painter and art educator, her work celebrates colour, storytelling and a sense of wonder, making it the perfect visual introduction to this collection of recipes.

WHERE WE ARE [AND WHERE WE'RE GROWING]

Wherever we go, plants will be a part of our story.

Humans have relied on plants for millennia. As we continue to explore new frontiers, especially space, plants will play an increasingly vital role in supporting life both on and off-planet.

Developing reliable Bioregenerative Life Support Systems (BLSS) will be a priority for future crewed missions to the Moon and Mars. These systems will harness the power of plants to provide clean air, essential nutrition, on-demand medicines or materials, and even psychological benefits for astronauts on long-duration missions. Advances in these areas will reap benefits in many aspects of life on Earth, including nutrition, food security, and sustainability.

The space environment comes with a unique set of challenges, but it also provides a setting for innovation and discovery. The **ARC Centre of Excellence in Plants for Space (P4S)** is part of a global community working to transform the way we grow and use plants for the benefit of all humankind.



WELCOME

In the spirit of reconciliation, Plants for Space acknowledge the Traditional Custodians of Country throughout Australia and their deep connections to land, sea, and sky. We pay our respect to their Elders past and present and extend that respect to all Aboriginal and Torres Strait Islander peoples today.

To celebrate National Science Week, our team put out an open call for recipes from a global network of Plants for Space researchers, collaborators and members of the community.

This book is a selection of our favourites, hand-picked for your enjoyment!

Inside, you'll find a range of nutritious (and delicious) foods that are directly inspired by space research. From real plant-based ingredients being studied for space habitation to foods that make us feel connected to our home planet, each recipe is packed with a generous helping of science – and a pinch of imagination.

Whether it's through trying something new in the kitchen or sharing your 'cosmic cuisine' with friends and family, we hope this book inspires you, too.

Happy cooking!



Australian Government
Australian Research Council



The ARC Centre of Excellence in Plants for Space is an international research consortium building novel solutions for long term space habitation and on-Earth sustainability.

Our diverse team brings together a wide range of researchers in disciplines across plant science, nutrition, food science, engineering, psychology and space law.

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We extend our enormous gratitude to all who contributed their knowledge,
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SAFETY DISCLAIMER

The recipes and cooking information inside this book are for entertainment and educational purposes only.

The reader assumes full responsibility for using their best judgment when handling raw ingredients, and seeking information from an official food safety authority if they are unsure.

The reader must also take care to not physically injure themselves by coming into contact with hot surfaces, sharp blades, and other kitchen hazards. Recipes are intended exclusively for use by persons having appropriate technical skill, at their own discretion and risk.

It is the responsibility of the reader to review all listed ingredients in a recipe before cooking to ensure that none of the ingredients may cause a potential adverse reaction to anyone handling or eating the food. This includes but is not limited to allergies, sensitivities, or pregnancy-related diet restrictions.

For additional food and kitchen safety information, visit:

Eat for Health | <https://www.eatforhealth.gov.au/eating-well/food-safety>

Food Standards AUNZ | <https://www.foodstandards.gov.au/consumer>

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Supernova Energy Bowl

🕒 1 hr (+7 hours for soaking)

Recipe by Shu Linag and Volker Hessel

This 'powerfood' recipe combines seven space-adapted crops to meet astronauts' daily nutritional needs, including protein, dietary fibre, and essential micronutrients; designed for long-term missions.



INGREDIENTS

Salad

63 g soybean

155 g poppy seeds

223 g barley

79 g kale

25 g peanuts

642 g sweet potato

18 g sunflower seeds

Dressing

1 tbsp soy sauce

1 tsp vinegar

1 tsp olive oil

DIRECTIONS

Soak the soybeans and barley in plenty of cold water for at least 6 hours or overnight. Drain, then cook according to package instructions until tender. Allow to cool completely.

DIRECTIONS

Wash the kale and remove the thick stems. Blanch in boiling water for 30 seconds, or until just tender but still bright green. Drain and immediately cool under cold running water or in an ice bath. Drain well.

Peel the sweet potato and cut into 1 cm-thick slices. Steam for 10 minutes, or until tender but not mushy. Alternatively, roast at 200°C (180°C fan-forced) for 15 minutes, or until lightly charred and cooked through. Allow to cool slightly.

Place the peanuts, sunflower seeds and poppy seeds in a dry frying pan over low heat and toast for 2 minutes, stirring frequently, until fragrant. Alternatively, toast them in the oven until lightly golden.

Combine the cooked soybeans, barley, kale, sweet potato, peanuts, sunflower seeds and poppy seeds in a large bowl. Add the sauce and toss gently to coat before serving.

ABOUT THIS RECIPE



“A Supernova is a powerful and luminous stellar explosion, marking the explosive death of a star. Astronauts need the most powerful nutrient food for their energy-taking job. “

Volker Hessel is a P4S Chief Investigator. His work is exploring digital twin technology to model and optimize plant growth systems for space farming.

Celestial Cucumber Capsules

🕒 30 mins Recipe by Anshul Phaugat

Inspired by my research on growing nutrient-rich baby cucumbers in controlled-environment systems for space, these celestial Cucumber capsules show how fresh produce can be transformed into a compact, nutritious and appealing meal. The crisp cucumber, creamy avocado, tender tofu and crunchy capsicum also create contrasting textures, making future-focused foods more enjoyable and satisfying.



INGREDIENTS

- 5–6 baby cucumbers
- 1 ripe avocado
- 100 g finely chopped tofu or 2 boiled eggs
- 2 tbsp finely diced green capsicum
- 2 tbsp finely diced yellow capsicum
- 1 small red Thai chilli, finely chopped
- 1 small garlic clove, minced
- Juice of ½ lemon
- 1–2 tsp chilli oil
- Fresh dill and coriander, chopped
- Sriracha sauce, for drizzling

DIRECTIONS

Wash the cucumbers and cut them in half lengthways.

Scoop out the centres with a teaspoon to form cucumber boats. Finely chop the scooped cucumber and set aside.

Mash the avocado in a bowl. Add the chopped boiled eggs, cucumber, capsicums, Thai chilli, garlic, lemon juice, chilli oil, dill and coriander. Season with salt and mix until well combined.

Spoon the filling into the cucumber boats. Drizzle with sriracha and garnish with extra dill or coriander.

Space Salad

🕒 15 mins Recipe by Janine Oldfield

P4S is all about creating ingenious uses of plants, with a particular focus on nutritionally high pick-and-eat foods that require little processing by astronauts. What better way to use fresh food on board a spacecraft than a classic pick-and-eat salad that takes less than a minute to prepare!



INGREDIENTS

Rocket or other leafy greens, to fill a salad bowl

¼ cup pine nuts

Lemon vinaigrette

½ cup freshly squeezed lemon juice

¾ cup olive oil

1 tsp Dijon mustard

1 tsp honey

1 garlic clove, finely crushed

1 sprig fresh thyme, leaves picked

Salt and black pepper, to taste

DIRECTIONS

Combine the garlic, lemon juice, olive oil, Dijon mustard, honey, thyme, salt and black pepper in a small bowl.

Whisk until well combined.

Place the rocket and pine nuts in a large bowl. Add the dressing and gently toss to combine.

Serve immediately.

Abacha (African Salad)

🕒 30 mins Recipe by Ajuh Rita Omojo

Future space crews will come from many cultures, each with their own culinary traditions. Familiar meals can provide comfort and help reduce menu fatigue during long-duration missions. This plant-based version of the traditional West African dish abacha celebrates culinary diversity while adapting the recipe for a sustainable future in space.

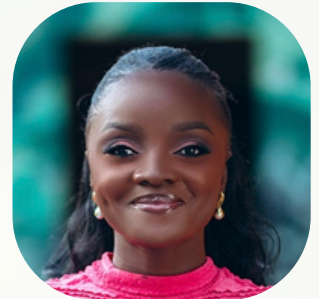


INGREDIENTS

- 250 g dried abacha *
- ½ cup palm oil
- ¼ tsp bicarbonate of soda
- 1 tbsp warm water
- 2 tbsp mushroom powder or finely ground dried shiitake mushrooms
- 1 tsp ground chilli, or to taste
- Salt, to taste
- 1 tsp ogiri, or 1 tsp miso (optional)*
- ½ cup ugba (fermented oil bean), if available
- ½ red onion, thinly sliced
- 1 cup garden egg leaves*
- 150 g smoked tofu or tempeh, diced*

ABOUT THIS RECIPE

Ajuh Rita Omojo is a Nutrition Scientist at the National Space Research and Development Agency (NASRDA), Nigeria, where her research explores the links



between nutrition, health and space science. An International Astronautical Federation Emerging Space Leaders Award recipient, she is passionate about developing sustainable food solutions for both space missions and life on Earth. Her recipe celebrates how flavourful, culturally significant meals can also deliver balanced nutrition for future space crews.

***Abacha**, is made from dried, shredded cassava and is available from African grocery stores and online retailers.

***Ogiri** is a traditional West African fermented seasoning that adds a rich umami flavour. If unavailable, substitute with a small amount of miso.

***Garden egg leaves** have a mild, slightly bitter flavour. If unavailable, substitute with baby spinach, Asian greens or other tender leafy greens.

***Ugba** is made from the fermented seeds of the African oil bean tree and adds a distinctive flavour and texture to abacha. It is available from African grocery stores and online retailers.

Traditionally, this dish is prepared with ground crayfish and pieces of cooked stockfish. In this plant-based version, mushroom powder provides a similar savoury umami flavour, while smoked tofu or tempeh replaces the fish with a satisfying source of plant protein.

DIRECTIONS

Soak the dried abacha in warm water for 10-15 minutes, or until softened. Rinse with cold water and drain well.

Dissolve the bicarbonate of soda in the warm water. Gradually stir into the palm oil until it thickens and becomes creamy.

In a large bowl add the mushroom powder, chilli, salt and ogiri or miso, if using, and mix well.

Add the softened abacha and toss until evenly coated.

Fold through the ugba, sliced onion, garden egg leaves and smoked tofu or tempeh.

Taste and adjust the seasoning as needed.

Serve at room temperature.

‘Moon Squirter’ Medley

🕒 1 hr Recipe By Kim Johnson

“I will never, not ever, eat a tomato” claims Lola in the popular book series, Charlie and Lola by Lauren Childs. Charlie cleverly offers Lola ‘moon squirter’ and she eats these delicious juicy treats in a lunar adventure.

INGREDIENTS

Salad

200g cherry tomatoes, halved

100g yellow cherry tomatoes, halved

100g tiger tomatoes, quartered

150g red and yellow tiny toms

2 mini cucumbers, sliced into rounds

For added fibre (optional)

125 g couscous

125 g prepared quinoa



Dressing

1 tbsp Olive oil

1 tsp balsamic vinegar

1 garlic clove, crushed

4 tbsp roughly chopped herbs (e.g. mint, oregano, basil)

DIRECTIONS

Arrange the cherry tomatoes, cut-side up, on a baking tray. Sprinkle with the sugar and salt, then drizzle with a little oil.

Bake at 180°C for 20 minutes. Turn off the oven and leave the tomatoes inside for a further 10 minutes. Remove and allow to cool.

Combine the oil, vinegar and garlic in a small bowl and whisk until combined.

Place all ingredients in a large bowl and gently toss to combine.

ABOUT THIS RECIPE

Kim Johnson is a P4S Chief Investigator. Her work aims to optimise tomatoes and cucumbers to grow in space.



“I hope this dish will excite off-world adventurers and provide them brilliant colour, flavour and nutrition!”



MARCHANTIA

Marchantia polymorpha, a species of liverwort, is a promising space food for long missions, generating edible biomass under limited resources.

Marchantia requires no soil and grows with minimal water and space. Its tolerance to low light and capacity for clonal propagation enable efficient biomass production, while essential nutrients enhance its nutritional value.



Check out all five Marchantia recipes throughout this book:

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SAFETY NOTE

Plant scientists at the University of Kobe are investigating liverwort for its high nutritional content when compared to traditional ‘pick and eat’ crops. We thank them for their unique contributions to this cookbook! Whilst some varieties are being developed as a potential food source, wild-growing liverwort can be unsafe (and not very tasty).

Do not consume wild or non food-grade marchantia. If you’re looking for a simple substitute, try seaweed (Nori or Wakame) or spinach for a similar texture and flavour!

Marchantia Green Salad

🕒 10 mins Recipe by Yuasa M, Koyama R, Ishizaki K, Mizutani M

Inspired by advances in aeroponic cultivation, this dish explores the potential of Marchantia (a species of liverwort) as a sustainable food source for space.

INGREDIENTS

Salad

40 g Marchantia
40 g lettuce
40 g tomato
40 g cucumber

French dressing

2 tsp vinegar
1 tbsp vegetable oil
1 g salt
1 pinch pepper



DIRECTIONS

Wash the Marchantia, lettuce, tomato, and cucumber, removing any excess water using a paper towel.

Tear the lettuce, cut the tomato into wedges, and slice the cucumber into rounds.

To prepare the dressing, combine and mix vinegar, oil, salt and pepper in a separate bowl or jug.

Arrange the cut vegetables in a bowl and pour over dressing to taste.

Japanese Marchantia and Green Strawberry Sauce

🕒 1 hr 30 mins Recipe by Shimamura M, Yuasa M, Koyama R, Ishizaki K, Mizutani M

This simple sauce makes the most of naturally sweet and tart strawberries while using only a few ingredients.

It is designed to use thinned strawberries that might otherwise go to waste, demonstrating how resource-efficient cooking can support future space food systems. Its simple preparation also makes it well suited to environments where energy and resources are limited.



INGREDIENTS

25 g of Marchantia
25 g of thinned strawberries
1 tsp sugar
2 tsp water
1 tsp soy sauce

Food safety note - pg 16

DIRECTIONS

Wash the Marchantia and strawberries, then pat dry. Remove the strawberry stems and cut the fruit into 5 mm pieces.

Combine the strawberries, sugar, water and soy sauce in a small saucepan.

Cook over medium heat for 5 minutes, stirring occasionally.

Add the Marchantia and cook for a further 2 minutes.

Serve warm with meat, fish or plant-based alternatives.

Nikujaga (Japanese stew) with Marchantia and Soy Meat

🕒 1 hr 30 mins Recipe by Shimamura M, Yuasa M, Koyama R, Ishizaki K, Mizutani M

This recipe shows how simple plant-based ingredients can create a nutritious and satisfying meal. Dried soy meat has a long shelf life, while Marchantia is being explored as a crop that could be grown in resource-limited environments, including space.

The cooking liquid can also be used as an umami-rich broth, making the most of every ingredient and reducing food waste.



INGREDIENTS

- 40 g Marchantia
- 1 potato (100 g)
- 1 onion (150 g)
- 50 g dried soy meat
- 1 tsp rapeseed oil
- 1 cup water
- 2 tbsp soy sauce
- 15 g sugar

DIRECTIONS

Soak the soy meat in the seasoning liquid for 30-60 minutes.

Wash the potatoes, remove any sprouts and cut into quarters. Peel the onion and cut into 8 wedges. Wash the Marchantia and pat dry.

Heat the rapeseed oil in a saucepan over medium heat. Add the potatoes and cook for 5 minutes, then add the onion and cook for a further 3 minutes.

Add the rehydrated soy meat and the soaking liquid. Simmer for 10 minutes. Stir in the marchantia and cook for 1 minute, then serve immediately.

Food safety note - pg 16

Marchantia Omelette

🕒 10 mins Recipe by Shimamura M, Yuasa M, Koyama R, Ishizaki K, Mizutani M

This Marchantia omelette is flavourful and nutritious.

The dish is rich in egg-derived protein and liverwort-derived iron, both of which are essential for activities in space!



INGREDIENTS

4 eggs
2 tbsp milk
60 g Marchantia
1 tbsp of butter
2 tbsp tomato ketchup
10 g Marchantia (garnish)
Salt and pepper to taste

DIRECTIONS

Wash the Marchantia and remove the excess water using a paper towel.

Blanch the marchantia, then remove any excess water using a paper towel.

Crack and beat eggs, and stir in the milk, salt, and pepper. Combine the blanched Marchantia and egg mixture.

Melt the butter in a pan and pour the egg mixture into it.

Mix well, make flat with a wooden spoon and form an omelette shape.

Plate up the omelet, add the tomato ketchup, and garnish with fresh Marchantia.

Food safety note - pg 16

Jumpin' Jupiter Hummus

🕒 15 mins Recipe by Douglas Bair

The swirling colours of this hummus are inspired by the cloud bands of Jupiter. Creamy hummus and smoky chipotle create a rich, bold flavour that pairs perfectly with crisp, fresh vegetables such as carrots, cucumbers and capsicum. Serve with warm flatbread or pita chips for a simple snack or shared platter.



INGREDIENTS

1 can chickpeas or 1 ½ cups prepared chickpeas
¼ cup tahini
1 to 3 garlic cloves
2 tbsp lemon juice
½ tsp salt
2 tbsp chipotle peppers in adobo sauce
1 tsp cumin
2 tbsp olive oil
5- 10 tbsp ice water
½ tsp paprika

DIRECTIONS

Combine the garlic, lemon juice and salt in a small bowl. Set aside for 10 minutes.

Blend the tahini in a food processor for 1 minute. Add the garlic mixture, cumin and 2-3 tablespoons of water, then blend until smooth.

Add the drained and rinsed chickpeas and olive oil. Blend until smooth, adding extra water as needed to achieve a creamy consistency. Taste and adjust the seasoning.

Transfer two-thirds of the hummus to a bowl. Add the chipotle peppers to the remaining hummus and blend until smooth.

Spoon the plain and chipotle hummus onto a serving platter and swirl together. Drizzle with olive oil, sprinkle with paprika and serve.

Dr Flav's Mushroom Soup

🕒 55 mins Recipe by Flávia Fayet-Moore

Mushrooms will help provide essential nutrients for astronauts in deep space and bring that deep, savoury umami flavour that makes every spoonful feel comforting and rich...

An essential recipe when in space, away from the comforts of food on Earth.

INGREDIENTS

20 g dried porcini mushrooms
250 ml freshly boiled water
400 g mushrooms (sliced or chopped)
3 tbsp olive oil
3 shallots
2 cloves of garlic
2 leeks
1.5 L vegetable stock
1/2 tsp dried thyme
300 ml thickened cream



To garnish (optional)

Fresh thyme
Enoki mushrooms
Kosher salt

DIRECTIONS

Place dried porcini in a bowl and cover with a cup of warm water. Let soak for 20-30 minutes. Once softened, lift out the mushrooms and squeeze out excess liquid back into the bowl. Strain and reserve the soaking liquid, then finely chop the porcini.

Wipe clean or wash fresh mushrooms, and slice or chop into bite-sized pieces. Set aside.

Heat olive oil in a large pot over medium heat. Add finely chopped shallots, garlic, and leeks. Cook gently for 5-7 minutes until softened.

Stir in the chopped fresh mushrooms and porcini. Cook for 5-8 minutes, until the mushrooms start to soften and release their juices.

Add the vegetable stock, reserved porcini soaking liquid, dried thyme, salt and pepper to taste. Bring to the boil, then reduce heat to a simmer. Cover loosely and cook for about 25-30 minutes.

Blend about $\frac{3}{4}$ of the soup using a blender or stick blender until silky, and return the blended mixture to the pan and combine with the remaining soup.

With low heat, stir in thickened cream, and warm through for 5 minutes. Check the consistency and add more stock if needed.

Adjust seasoning to taste, then ladle into bowls and garnish with fresh thyme and pan-fried or air-fried enoki mushrooms (if using). Serve hot.

ABOUT THIS RECIPE



“I chose this recipe because I sent oyster mushrooms to space on the Fram2 spaceflight!

It also packs a serious nutritional punch with fibre, B vitamins, selenium and vitamin D (if you pop them in the sun for about 15 min before cooking!)”

Flávia Fayet-Moore is a Brazilian-born, Canadian-raised, Australian-made scientist, international keynote speaker and space nutritionist. She is a partner investigator with P4S, Space Farming Brazil, a core instructor with Austronaut and a founding member of the Space Nutrition Network.

Tempeh "Goreng"

🕒 5 mins Recipe by Lydia Ong

Tempeh is a traditional Indonesian food made by fermenting soybeans with a beneficial mould, usually *Rhizopus oligosporus*.

The fermentation process is simple and can be carried out at home with minimal equipment.



INGREDIENTS

1 block (~300 g) Tempeh

Vegetable oil

Salt to taste

DIRECTIONS

Slice the tempeh into 5 mm thick rectangles.

Heat a little oil in a frying pan over medium heat and fry for 2–3 minutes on each side, or until golden and crisp. Drain on paper towel and season with salt.

Alternatively, air-fry at 180°C for 12 minutes, or until crisp. Serve as a snack, in salads, or with a spicy dipping sauce.

ABOUT THIS RECIPE

Lydia Ong is a P4S researcher. Her work looks to develop future foods from plants grown in space.



“Growing up in Indonesia, a serve of tempeh was always part of our weekly family meals. Tempeh is widely valued for its high protein and nutritional content. This is particularly important in regions where meat can be expensive and less accessible for many people.”

Gado Gado Tempeh Salad

🕒 30 mins

INGREDIENTS

Salad

300g prepared tempeh
3 medium potatoes
1 medium carrot
1 medium cucumber
150 g bean sprouts
300 g green beans
1/2 cup coriander

Peanut Sauce

1/3 cup peanut butter
4 tsp kecap manis
1 tsp sambal oelak
1 tsp brown sugar
1 ½ tbsp lime juice
60 ml coconut milk
1 clove minced garlic
2 tsp minced ginger



DIRECTIONS

Cut the potato into bite-sized pieces and boil until tender. Drain and allow to cool.

Trim the green beans. Julienne the carrots and cucumber. The vegetables can be served raw, or lightly blanched and cooled.

To make the peanut sauce, combine all sauce ingredients in a small saucepan. Whisk over low heat until smooth, adding a little water as needed to achieve a thick, pourable consistency.

Arrange the potato, vegetables and prepared tempeh on a serving platter and drizzle with the warm peanut sauce.

Other vegetables can be added or substituted, including spinach, Asian greens, zucchini, wombok, capsicum or tomatoes!

Pickle-4: Martian Mustard Edition

🕒 1 hr 30 mins (+ 2 days fermentation)

Recipe by Jalitha Wanni Arachchige

The name Pickle-4 celebrates Mars as the fourth planet in our solar system. Mustard greens are a nutritious and promising crop for future space farming, making this recipe a tasty nod to astronaut nutrition!



INGREDIENTS

100 g mustard greens (gai choy)	1/4 cup vinegar
1/2 tbsp salt	1 tbsp sugar

For added flavour (optional)

Finely minced garlic
Dried chilli flakes

DIRECTIONS

Wash mustard greens thoroughly, pat dry, and slice into 1/3-inch strips, removing any tough stems.

Place the chopped greens in a large non-metal bowl, sprinkle with salt, and massage gently for about a minute to soften. Let sit for 1 hour.

Rinse the greens to remove excess salt, then squeeze firmly until very dry and pack tightly into a clean, sterilized glass jar.

In a small pot, combine vinegar and sugar. Simmer over medium heat until the sugar dissolves, then remove from the heat and let the brine cool to room temperature.

DIRECTIONS

Pour the cooled brine over the greens, ensuring they are fully submerged. Tap the jar gently to release any air bubbles.

Cover the jar loosely with a lid and let it sit at room temperature for 24 hours.

After fermenting, seal the jar tightly and move it to the refrigerator. Let it sit for at least one more day before eating.

ABOUT THIS RECIPE

Jalitha Wanni Arachchige is a PhD candidate in Chemical Engineering at the University of Melbourne.

His work focuses on developing sustainable ‘microbial cell factories’ that can produce useful nanoparticles for medicines, biosensors and more.



“With its long shelf life, tangy flavor, and gut health benefits, these pickled mustard greens are ideal for space missions where sustainability, nutrition, and storage efficiency are crucial.”

Karkalla Relish

🕒 45 mins Recipe by Rebecca (Bec) Moon

Karkalla, also known as bain or pigface, is a native Australian coastal succulent that has been enjoyed by First Nations peoples for tens of thousands of years. Its leaves, flowers and fruit are all edible, with the succulent leaves offering a distinctive salty flavour. This relish celebrates karkalla's unique taste, creating a fresh, savoury accompaniment to a wide range of dishes.



INGREDIENTS

500 g karkalla leaves,
chopped
100 g onion, finely
diced
30 g cooking salt
150 g caster sugar
350 mL white vinegar
2 garlic cloves,
crushed
3 pepperberries,
crushed
½ tbsp mustard seeds
½ tbsp celery seeds

DIRECTIONS

Chop the karkalla leaves, discarding the stems and any damaged leaves. Finely chop by hand or pulse in a food processor, taking care not to over-process. Drain any excess liquid.

Combine the sugar, vinegar, garlic, mustard seeds, celery seeds and crushed pepperberries in a large non-reactive saucepan. Bring to the boil.

Add the chopped karkalla and return to the boil. Reduce the heat and simmer for 20 minutes.

Allow to cool slightly before transferring to sterilised jars.



“Karkalla is incredibly resilient. If any plant could grow in space, this would be one of them!”

Bec Moon is an Aboriginal Learning Facilitator at the Royal Botanic Gardens Cranbourne, Victoria and a chef with more than 35 years of experience. She is passionate about bushfoods, sharing culture and storytelling through food. Her Karkalla relish celebrates one of Australia's remarkable native plants and its potential as a resilient food for the future.

Soy and Chickpea Miso

🕒 6 months to 3 years Recipe by Guanqiu Huang

Miso is a traditional Japanese seasoning made from fermented soybeans. In 2020, it became one of the first fermented foods produced aboard the International Space Station.

With its unique umami flavour, miso may help counter the reduced sense of taste experienced by astronauts in microgravity.

INGREDIENTS

150 g dried chickpeas	200 g sea salt
250 g dried soy beans	Alcohol for sanitizing
375 g koji rice	

DIRECTIONS

Rinse the chickpeas and soybeans, then soak in water for 24 hours.

Drain and place in a large saucepan. Cover with fresh water and simmer for about 3 hours, or until very soft.

Meanwhile, prepare the rice koji according to the package instructions.



DIRECTIONS

Drain the cooked beans and blend into a smooth paste. Allow to cool to below 40°C.

Combine the bean paste, rice koji and sea salt, mixing thoroughly.

Sanitise a 2L food-grade plastic container with alcohol. Transfer the mixture to the container, pressing it down firmly to remove any air pockets.

Sprinkle a little extra salt over the surface. Cover with cling film and place a clean weight on top. Store in a cool, dark place for at least 6 months, or up to 3 years for a deeper flavour.

ABOUT THIS RECIPE

Miso is a traditional Japanese seasoning made from fermented soybeans. In 2020, it became one of the first fermented foods produced aboard the International Space Station.

After 30 days of fermentation, the space-grown miso developed unique microbial and flavour characteristics while remaining recognisably miso. The experiment showed that fermentation is possible in space and may support future long-duration missions. Its rich umami flavour may also help counter the reduced sense of taste experienced by astronauts.

Koji rice, sometimes referred to simply as rice koji or malted rice, is steamed rice that has been inoculated with the beneficial mold *Aspergillus oryzae*. It is available from specialty Asian grocery stores and online suppliers.

The *Aspergillus oryzae* mould produces enzymes that break down complex starches and proteins into simpler sugars and amino acids. These enzymes play a key role in the fermentation process and are essential for making miso from soybeans, chickpeas, and other legumes.

Miso Roast Cauliflower and Crispy Chickpeas

🕒 45 Min Recipe by Thomas Cobbinah

Roasting brings out the natural sweetness of the cauliflower, while the miso glaze adds a rich, savoury umami flavour. Crispy spiced chickpeas provide a satisfying crunch, while the creamy sauce ties the dish together. Combining contrasting flavours and textures can help reduce menu fatigue, making meals more enjoyable on long-duration space missions. This recipe also shows how a simple pick-and-eat crop such as cauliflower can become the centrepiece of a complete, satisfying meal.



INGREDIENTS

Cauliflower

- 1 large head of cauliflower cut into bite-sized florets
- 2-3 tbsp miso (white or yellow)
- 4 tbsp olive oil
- 1 tbsp maple syrup
- 1 tbsp soy sauce
- 1 tsp mirin

Chickpeas

- 1 can chickpeas
- 2 tbsp olive oil
- ¼ tsp chilli oil
- ¼ tsp ground ginger
- ¼ tsp garlic powder

Sauce

- 4 tbsp tahini
- 4 tbsp Japanese mayo
- 1 tbsp rice wine vinegar
- 1 tbsp soy sauce
- 1 tsp mirin
- 1 tsp toasted sesame oil

DIRECTIONS

Preheat the oven to 220°C and line two baking trays with baking paper.

Combine the marinade ingredients in a large bowl. Add the cauliflower and toss until evenly coated. Spread over one baking tray and roast for 25-30 minutes, or until tender and caramelised around the edges.

Drain and rinse the chickpeas. Toss with the olive oil, chilli, ground ginger, garlic powder, salt and black pepper. Spread over the second baking tray and roast for 20-25 minutes, or until crisp.

To make the sauce, combine all ingredients in a small bowl and whisk until smooth, and add cold water to thin to the desired consistency.

Arrange the roasted cauliflower on a serving platter and top with the crispy chickpeas. Drizzle with the sauce before serving.

Miso Glazed Carrot with Carrot Top Pesto

🕒 45 min Recipe by Frazer Thorpe

Plants for Space is exploring ways to make the most of every part of the plant. This recipe pairs sweet roasted carrots with a fresh carrot top pesto, turning an often-discarded ingredient into a vibrant, peppery sauce. Make a double batch of the pesto to toss through pasta, spread on sandwiches, or serve as a dip.



INGREDIENTS

Carrots

2 tbsp miso
4 tbsp olive oil
1 tbsp maple syrup
1 tsp soy sauce
1 pinch ground pepper
500 g small to medium carrots, peeled and halved lengthwise

Pesto

1 bunch carrot tops (4-6 carrot tops)
1 cup fresh basil
1 garlic clove
½ cup nuts or seeds of choice e.g. pine nuts, walnuts, sunflower seeds
⅓ cup olive oil
½ tsp salt
2 tbsp nutritional yeast or Parmesan

DIRECTIONS

Pesto

Combine the nuts or seeds, garlic, lemon juice, salt, nutritional yeast, carrot tops and fresh herbs in a food processor or blender. Blend, drizzling in the olive oil until smooth, scraping down the sides as needed. Taste and adjust as required. Use immediately, or transfer to a jar and refrigerate for up to 1 week.

Carrots

Preheat the oven to 220°C and line a baking tray with baking paper.

Toss the carrots with half the olive oil and season with salt and black pepper. Spread evenly over the prepared tray and roast for 15 minutes.

Meanwhile, combine the miso, remaining olive oil, maple syrup and soy sauce in a small bowl.

Remove the carrots from the oven and brush or spoon the glaze over them. Return to the oven and roast for a further 15 minutes, or until the carrots are tender and the glaze has caramelised.

Arrange the carrots on a serving platter and drizzle with the carrot top pesto before serving.

Classic Romesco-Style Space Spread

🕒 10 min Recipe by Joanna McMillan



Perfect on flatbreads, crackers or as an all-purpose dip, this recipe features leafy greens that can be grown in space.

These not only add valuable nutrition, but give a sense of health and freshness – important for astronauts who survive on many dried foods.

INGREDIENTS

1 cup packed leafy greens
(e.g. red romaine, mizuna, pak choi)
2 tbsp extra virgin olive oil
1 tbsp sunflower seeds or pumpkin seeds
(toasted if possible)
1 tsp rehydrated garlic (or ½ tsp garlic powder)
1 tsp lemon juice or apple cider vinegar
¼ tsp sea salt (adjust to taste)

For added flavour (optional)

Pinch of chilli flakes or cracked black pepper
½ tsp dried herbs (e.g. thyme, oregano)

DIRECTIONS

Lightly rinse the leafy greens, or wipe thoroughly with a food-safe produce wipe. Roughly chop or tear into smaller pieces.

Combine ingredients in a small bowl or pouch. If using dehydrated garlic, rehydrate it with a few drops of warm water for 1–2 minutes.

Stir vigorously with a spoon or shake in a sealed pouch until ingredients are well combined and slightly mashed. If a blender or food processor is available, pulse briefly for a smoother texture.

Spread onto whole grain tortillas, use as a dip, or spoon over rehydrated grains or legumes.

Chill and store leftovers in an airtight pouch or container.

Wattleseed Custard Tart

🕒 2hr + setting time Recipe by Katherine Bennell-Pegg

This recipe, a classic Aussie custard tart, gets its coffee-like flavour from roasted wattleseed.

Now, you can try this native superfood in your own kitchen!



INGREDIENTS

1 sheet shortcrust pastry	12 egg yolks
500 ml pouring cream	1 vanilla bean or 1 tsp vanilla bean extract
50 g double cream	
50 g cream cheese	2 tsp toasted wattleseed
120 g brown sugar	

Toppings (optional)

Orange Jelly Topping

3-4 oranges
70 g caster sugar
5 g citric acid
5 g pectin

Macadamia Crumb

250 g macadamia nuts
1 tsp melted butter
Sea salt to taste

DIRECTIONS

Tart Base

Preheat oven to 180°C. Line a 9.5-inch tart tin with shortcrust pastry (homemade or premade), trimming off excess.

Loosely cover the lined tart tin with aluminium foil, and bake for 25-30 minutes or until edges are golden brown. Remove tart shell from oven to cool.

DIRECTIONS

Optional: place lined tray of macadamia nuts in the oven and roast for 10 minutes. After removing the macadamia nuts, reduce the oven temperature to 120°C.

Filling

Place 12 egg yolks into a large mixing bowl. Place the cream cheese, double cream, pouring cream, sugar, vanilla and wattleseed into a saucepan.

Slowly bring the cream cheese mixture to a boil, stirring until fully combined. Once the mixture begins to simmer, immediately take it off the heat.

Slowly and gradually pour the cream mixture (~1/2 cup at a time) into the egg yolk, whisking rapidly until combined. Use a hand blender to blend the custard until it looks smooth and glossy - avoid bubbles in the mixture.

Remove any lumps by pouring the mixture through a sieve. While still hot, pour the custard mixture into the tart tin and place immediately into the oven.

Bake at 120°C for 25-30 minutes. When ready, the custard will wobble slightly when you shift the tart tin. Remove from oven and cool in fridge for at least 2 hours before serving.

Toppings

Juice 3-4 oranges (~200ml of orange juice), and finely grate ¼ cup of orange zest. Mix the pectin and sugar in a bowl, ensuring it is fully dissolved.

Place the orange juice and the zest in a saucepan and bring to a boil, stirring consistently. Once boiling, whisk in the sugar and pectin mixture.

Bring back to a boil then add the citric acid. For a more 'sour' flavour, add more citric acid to taste! Remove from heat and sieve the mixture to remove the zest.

DIRECTIONS

While the tart is cooling, gently pour the orange jelly over the top. Return to fridge and allow the dish to fully set. If you have already cooled the jelly in the fridge, it can be easily re-melted over low heat for this step.

To finish, blend the macadamia nuts with a teaspoon of melted butter and salt to taste. Sprinkle on top of the tart and serve!



ABOUT THIS RECIPE

Wattle is the national floral emblem of Australia, and has long been used as a nutrient-packed staple in Indigenous bush food.

In 2021, the Australian Space Agency, Japan Aerospace Exploration Agency and One Giant Leap Australia hosted 'What'll Happen to the Wattle', allowing over 270 Australian schools to grow space-flown wattle seeds.

Katherine Bennell-Pegg is the first professional astronaut to officially represent Australia.

As part of her work at the Australian Space Agency, the space systems engineer-turned-astronaut (and 2026 Australian of the Year) is inspiring the next generation to pursue a career in the fields of science, technology, engineering, and mathematics.

Asteroid Cake

🕒 30 min Recipe by Kate Kitagawa

The cake looks like a small asteroid. All the ingredients are vegan and come from plants that could be grown in space using special growing boxes. This shows how people might make healthy food for astronauts in the future.



INGREDIENTS

200 g firm tofu well drained
1½–2 tbsp cornstarch
1½–2 tbsp rice flour
1–2 tsp cocoa powder
Dried cranberries, roughly
chopped
Dried walnuts
Neutral oil (for greasing the pan)

Optional

Pinch of salt or sugar (depending
on whether you want it more
savoury or sweet!)

DIRECTIONS

Crumble the drained tofu into a bowl, leaving a little texture.

Add the cornflour, rice flour and cocoa powder, mixing until a thick batter forms. Fold in the cranberries and walnuts.

Heat a lightly greased non-stick frying pan over medium heat. Place a round ring mould or food ring in the pan.

Spoon the tofu mixture into the mould and press gently into an even layer. Cook for 5–7 minutes, or until the base is set and lightly golden.

Carefully remove the mould, turn the cake over and cook for a further 4–6 minutes, or until firm.

Allow to rest for a few minutes and garnish with more walnuts and cranberries before serving.

Dried Marchantia Cookies

🕒 30 min Recipe by Yuasa M, Koyama R, Ishizaki K, Mizutani M

These cookies made with dried Marchantia are sweet, matcha-flavored, palatable, and nutritious. This would be the perfect baked good for a break in space life.



INGREDIENTS

100 g of fresh Marchantia grown under controlled conditions, dried, and powdered
95 g wheat flour
5 g dried Marchantia powder
40 g of sugar
20 g egg
40 g unsalted butter
3-4 drops of vanilla essence

Food safety note - pg 16

DIRECTIONS

Wash the Marchantia and pat dry with paper towel. Dry in a food dehydrator until crisp, then grind to a fine powder.

Preheat the oven to 170°C and line a baking tray with baking paper.

Cream the butter and sugar until light and fluffy. Beat in the egg and vanilla.

Combine the flour and Marchantia powder, then gradually add to the butter mixture, stirring until a soft dough forms.

Roll the dough to 5 mm thick. Refrigerate for 20 minutes, then cut into 3 cm rounds using a cookie cutter.

Place on the prepared tray and bake for 10 minutes. Allow to cool on the tray before transferring to a wire rack.

No-Bake Strawberry Overnight Oats

🕒 10 min (+ overnight) Recipe by Maddy Parks

This recipe is no-bake, simple to assemble and highlights the use of strawberries as a 'pick-and-eat' crop for space.

High in vitamin C and dietary fibre, this is a balanced breakfast that can be adjusted to your preference of sweetness and flavour!



INGREDIENTS

250 g fresh strawberries
250 g yoghurt of choice
1/2 cup rolled oats
1 cup water or plant milk
1 tbsp maple syrup, honey
or jam

To garnish (optional)

Toasted muesli or nuts

DIRECTIONS

In a small bowl, combine oats and your choice of water or plant milk. Stir in 1/2 tbsp of your sweetener of choice and set aside.

Chop strawberries into approx. 1 cm cubes or slices.

In a cup or jar, place alternating layers of yoghurt, oat mixture, strawberries and your remaining sweetener.

Serve immediately or leave to set in the fridge overnight.

Optional: save the offcuts from your strawberries to brew a refreshing strawberry leaf tea.

Stellar Berry Cake

🕒 50 min Recipe by Christine Feinle-Bisset

Diets of astronauts are often bland and unimaginative. This cake, with its bright red dots, will add colour and taste to the diet!

It is quite moreish, even on Earth...



INGREDIENTS

160 g baker's flour

120 g caster sugar

1.5 tsp baking powder

1 pinch salt

40 g freshly squeezed

orange and/or lemon juice

1-2 tbsp orange and/or lemon zest

100 g raspberries (fresh or frozen)

110 g plant-based yoghurt

65 g safflower or sunflower oil

Icing sugar for dusting

DIRECTIONS

Heat oven to 170 °C, with a baking rack on the bottom-middle level. Grease the base and sides of an 18-cm diameter cake tin.

Place flour, sugar, baking powder and salt in a bowl and mix together with a spoon.

Combine yoghurt, oil, juice and zest in a bowl and blend together using a spoon. Add to dry ingredients and combine using a wooden spoon. The batter will be sticky and quite firm.

Carefully fold in approx. half the raspberries, then transfer mixture to the baking tin and even it out with a spoon. Sprinkle the remaining raspberries over the top.

DIRECTIONS

Bake the cake for 30-35 min. To test whether the cake is fully baked, insert a skewer in the centre. The cake is done when the skewer comes out clean.

Allow to cool in the tin, then transfer onto a wire rack or platter. Before serving, lightly dust with icing sugar.

ABOUT THIS RECIPE

“Hopefully in the not-too-distant future, some of the ingredients, such as the plant-based yoghurt and the berries, can be replaced by products grown and produced by P4S investigators; for example, 'yoghurt' made from protein extracted from duckweed, or complete-use strawberries...”

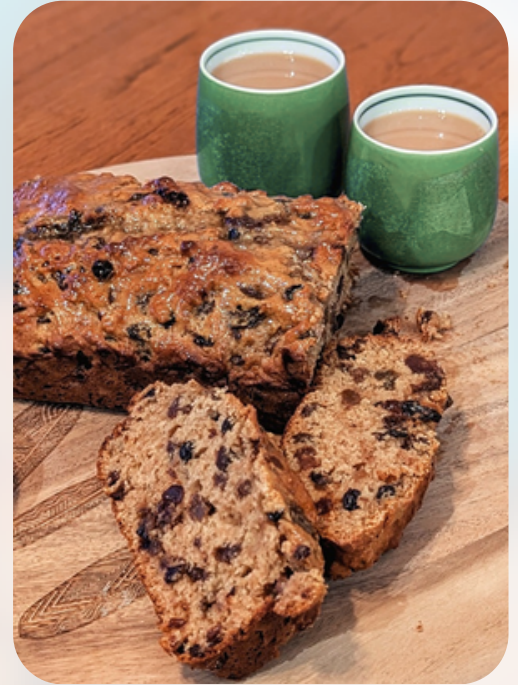
Christine Feinle-Bisset is a P4S Chief Investigator. Her work involves identifying new food products with high digestibility and nutritional value for both Earth and space.



Tea, Earl-Grey, Cake

🕒 1 hr (+ overnight soak) Recipe by Jenny Mortimer

The title is a nod to Captain Picard's iconic Star Trek replicator request: "Tea, Earl Grey, hot." As an explorer who values justice and connection, Picard is a favourite character. But tea is more than a sci-fi reference—it's a symbol of how plants shape culture.



INGREDIENTS

2 Earl Grey tea bags (or 5 g loose leaf tea, tied in muslin)

300 ml boiling water

250 g mixed dried fruit

275 g self-raising flour

60 g dark brown sugar

½ tsp baking powder

1 tsp ground mixed spice

90 g unsweetened vegan yoghurt e.g. soy

2 tbsp marmalade (optional)

DIRECTIONS

The night before, put tea bags and dried fruit in a heatproof bowl. Pour over freshly boiled water. Cover and leave to steep overnight.

The next day, preheat the oven to 180°C (160°C fan-forced). Lightly grease a 900 g loaf tin and line it with baking paper.

In a large bowl, mix the flour, sugar, baking powder and mixed spice. Add the yoghurt and fruit mixture. Squeeze out the tea bags to get all the flavour and discard. Stir well to ensure fully incorporated. Pour into prepared tin and level.

Bake for 1 hour, or until a skewer inserted into the centre of the loaf comes out clean.

Optional: Gently heat the marmalade in a small saucepan until melted, then brush over the top of the warm loaf to glaze.

Allow to cool slightly before slicing. Serve with freshly brewed tea.



Jenny Mortimer is a P4S Chief Investigator. Her work is reimagining plants as on-demand ‘biofactories’ for materials, medicines and other useful molecules.

“For millennia, tea has brought people together through ceremony and hospitality. In the UK, where I’m from, offering tea (and maybe cake!) is how we welcome someone into our home.”

Cosmic Duckweed Choc Chip Cookies

🕒 1 hr Recipe by Ella, Willow and Jordy

Our cookies are inspired by growing duckweed in space, a tiny, fast-growing, protein-packed plant perfect for astronauts. By turning it into powder and adding it to cookies, we mix science with comfort food, keeping astronauts nourished, happy, and connected to Earth while exploring new worlds.



INGREDIENTS

- 125 g butter, softened
- ½ cup brown sugar
- ¼ cup castor sugar
- 1 egg
- 1 tsp vanilla extract
- 1 cup plain flour
- ½ cup self-raising flour
- 2 tbsp duckweed powder
- ½ tsp baking powder
- ¼ tsp salt
- ¾ cup chocolate chips

DUCKWEED

Although duckweed grows naturally in Australian waterways, it is advised not to consume wild-sourced duckweed.

When cultivating duckweed for consumption, ensure high water quality and thoroughly rinse the duckweed before cooking.

You can find duckweed powder available at online specialty stores.

DIRECTIONS

Preheat the oven to 180°C and line a baking tray with baking paper.

Cream the butter and sugars together until light and fluffy. Beat in the egg and vanilla until well combined.

In a separate bowl, combine the plain flour, self-raising flour, duckweed powder, baking powder and salt. Gradually add the dry ingredients to the butter mixture and stir until just combined. Fold in the chocolate chips.

Roll the dough into small balls and place on the prepared tray, leaving space for spreading.

Bake for 10 minutes, or until the edges are golden and the centres are still soft. Allow to cool on the tray for a few minutes before transferring to a wire rack.

“Ella, Willow and Jordy are enthusiastic primary students from our rural school who share a passion for STEM, sustainability and space exploration.

Through the Plants for Space program, they explored how duckweed could help support future space missions by providing a nutritious and sustainable food source, while inspiring young minds to think creatively about solving real-world challenges.”



THANKS FOR READING!

Enjoyed this resource?

Follow our research journey and learn more about Plants for Space at:

www.plants4space.com 



**Wherever we go, plants will be a part of
our story.**

Inside this book, you'll find a range of nutritious (and delicious) foods from the community, directly inspired by space habitation and sustainability research.

We extend our enormous gratitude to all who contributed their knowledge, time and inspiration to this collection.