

AgriFutures
Emerging
Industries

HACCP Plan 1



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SCOPE

The purpose of this Food Safety Program is to identify and control, prevent and/or eliminate food safety hazards for the scope of growing, harvest, processing, packing of dried seaweed.

This HACCP Plan has been prepared in accordance with the CODEX Alimentarius Guidelines 97/13A 2020 revision for HACCP, Best Practices for the emerging Australian Seaweed Industry: Seaweed Quality Control Systems (iss Sept 2017) & Banach, JL, Hoek-van den Hil, EF, van der Fels-Klerx, HL. Food safety hazards in the European seaweed chain. *Compr Rev Food Sci Food Saf.* 2020; 19: 332– 364. <https://doi.org/10.1111/1541-4337.12523>



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HACCP TEAM

Name	Position	Qualification
Russel Crowe	CEO & company founder.	<ul style="list-style-type: none"> > HACCP Team leader. > Masters degree of Science (Marine Science). > PHd in (Marine Ecology). > HACCP Training Course 2018. > HACCP Refresher course 2021
Clare Winkel	Food Consultant	<ul style="list-style-type: none"> > HACCP Team member. > Bachelor of Applied Science (Biology). > MBA (Seafood Management) (Aust Maritime College). Distinction awarded for Dissertation: "Torres Strait Community based Fisheries: A review of methods of management & marketing of the community and biological sustainability relevant to maximising the fishery potential". > Registered National Food Safety Auditor- Level 4 – current. > International Meat and Poultry HACCP Alliance Lead Instructor in HACCP. Washington DC. USA
Chris Hemsworth	Seaweed production manager.	<ul style="list-style-type: none"> > HACCP Team Member > 7 years as the production manager. > Certificate IV in Assessment and Workplace Training > Associate Diploma in Applied Science (Biology). > HACCP Training Course 2016.

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PRODUCT DESCRIPTION

Product Name/Category	Dried Seaweed powder
Composition	100% dried Sea Lettuce: Ulva spp. (Ulvophyceae)
Method of Preservation	Drying resulting in controlled Water Activity.
Packaging Primary	Sealed, lidded cardboard jars made from 70% recycled material.
Packaging Secondary	Cardboard carton.
Storage Conditions	Ambient
Distribution Method	Ambient road transport
Shelf Life	2 years
Special Labelling	Made in Australia from 100% Australian ingredients.
Final Customer preparation	Used as an ingredient in other processed food i.e. within pasta, crackers, breakfast cereals, salts, snacks & seasonings.
Sensitive Customer	Made in premises that processes allergens including: shellfish, tree nuts, gluten based grains & sesame seeds.

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METHODOLOGY

The flow chart has been designed, so that each step has been allocated a number. **All steps that are repeated throughout the process have been allocated the same number**, to save repetition in the Risk Assessment Table.

The method used to establish CCP's within this HACCP Plan has been based on the significance of each hazard as determined by the Risk Analysis Table.

Hazards which can be controlled, prevented or eliminated by the application of Good Hygiene Practices (GHP) are not included in the HACCP Table. Therefore, these hazards have been identified in the Risk Analysis Table and have not been carried forward to the HACCP Table as CCP's.

All other hazards not controlled by GHP and defined as highly significant within the Risk Assessment Table have been carried over to the HACCP Table as a CCP. These hazards are all monitored and a record of that activity maintained.

Hazards defined as less than significant within the Risk Assessment Table are not carried over to the HACCP Table and may not be monitored or a record maintained.

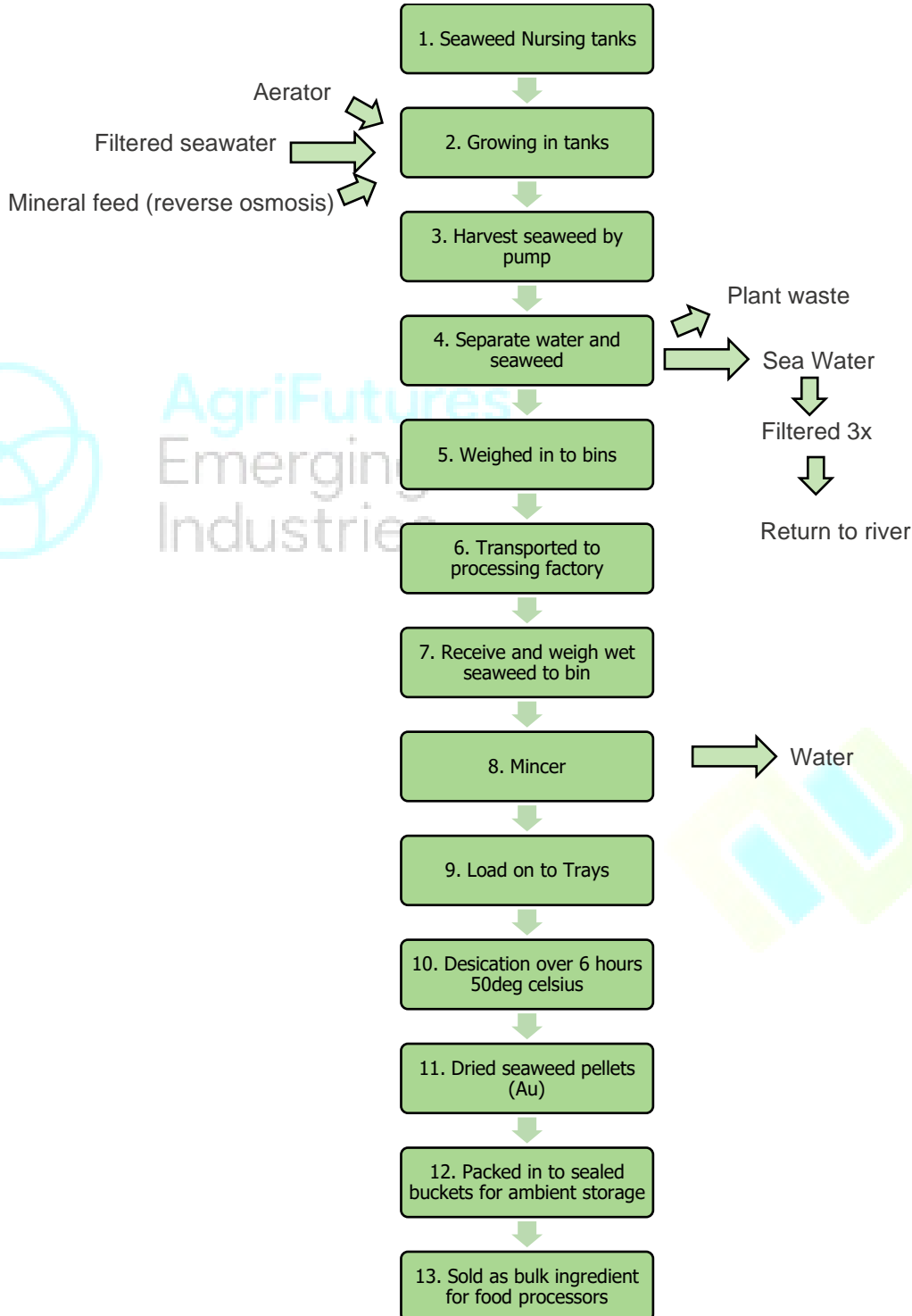
$$\text{Total Assessed Risk} = \text{Likelihood} \times \text{Severity}$$

Likelihood	Severity
1 = Improbable event: Once every five years	1 = Negligible: no impact or not detectable
2 = Remote possibility: Once per year	2 = Marginal impact: only internal company effected; production problems.
3 = Occasional event: Once per month	3 = Significant: impact on customer requirements and expectations: customer complaints.
4 = Probable even: Once per week	4 = Major: impact on legal requirements: consumer illness.
5 = Frequent event: Once per day	5 = Critical: public health risk, public product recall: consumer death.

	Severity				
Likelihood	1	2	3	4	5
1	1	2	3	4	5
2	2	4	6	8	10
3	3	6	9	12	15
4	4	8	12	16	20
5	5	10	15	20	25

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FLOWCHART



Verified By: Clare Winkel

Date: 30/3/22

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RISK ASSESSMENT FOR THE SEAWEED PROCESSING STEPS

Step	Potential Hazards	Cause	Sev *	Lik *	Sig*	Reasons for significance	CCP	Control measures
1. Seaweed growing in nursery tanks	Microbiological contamination & growth of bacterial pathogens & viruses: <i>Vibrio spp</i> , <i>Salmonella</i> , <i>E.coli</i> , <i>Shigella</i> , <i>Norovirus</i> & Hepatitis.	Contaminated water supply used in tanks. Contaminated mineral feed used.	5	2	10	Contaminated product entering production could affect all product and cannot be controlled at a later step.	CCP-Water quality used in growing tanks. CCP- Micro quality of mineral feed used.	Sea water pumped from river bottom at high tide then filtered (less than 0.1 micron) & salinity (25 parts per thousand) measured prior to use.
	Chemical contamination: arsenic, cadmium, iodine, pesticide residues, dioxins, polychlorinated biphenyls, brominated flame retardants, polycyclic aromatic hydrocarbons, pharmaceuticals, marine biotoxins & allergens.		4	1	8	The seaweed is grown in filtered river water that will remove any unknown chemical contaminants that may occur at an unknown frequency in the "open ocean".		Reverse osmosis undertaken on mineral feed from approved supplier.

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1. Growing seaweed in saltwater tanks.	Microbiological contamination & growth of bacterial pathogens & viruses: <i>Vibrio spp</i> , <i>Salmonella</i> , <i>E.coli</i> , <i>Shigella</i> , <i>Norovirus</i> & Hepatitis.	Contaminated water supply used in tanks. Contaminated mineral feed used.	5	2	10	Contaminated product entering production could affect all product and cannot be controlled at a later step.	CCP-Water quality used in growing tanks. CCP- Micro quality of mineral feed used.	Sea water pumped from river bottom at high tide then filtered (less than 0.1 micron) & salinity (25 parts per thousand) measured prior to use. Reverse osmosis undertaken on mineral feed from approved supplier. Water monitored automatically for the following attributes daily: -Oxygen levels. -Temperature. -pH. -Flow rate. -Salinity. -Species testing to identify any "rogue" seaweed.
	Chemical contamination: arsenic, cadmium, iodine, pesticide residues, dioxins, polychlorinated biphenyls, brominated flame retardants, polycyclic aromatic hydrocarbons, pharmaceuticals, marine biotoxins & allergens.		4	2	8	The seaweed is grown in filtered river water that will remove any unknown chemical contaminants that may occur at an unknown frequency in the "open ocean".		
3. Harvest by pumping out of the tank.	Microbial contamination (Staphylococcus aureus & Salmonella spp).	Staff not following Good Hygiene Practices. Contamination from birds.	5	1	5	Following Good Hygienic Practices should prevent the likelihood of contamination. Later steps will eliminate hazards.	No	Follow the work instructions for: -Personnel Hygiene Procedure (iss 11/1/22). -Employee Induction Program (iss 11/1/22).
	Physical contamination	Damaged product from bad handling practices/badly maintained equipment.	4	1	4	Following Good Hygienic Practices should prevent	No	Follow the work instruction for:

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						the likelihood of contamination.		-Maintenance Program (iss 11/1/22). -Seaweed Harvesting procedure (iss 11/1/22).
4. Separate seawater & seaweed	Physical contamination	Damaged product from bad handling practices/badly maintained equipment.	4	1	4	Following Good Hygienic Practices should prevent the likelihood of contamination.	No.	Follow the work instruction for: -Maintenance Program (iss 11/1/22).
5. Seaweed weighed into bins	Microbial contamination (Staphylococcus aureus & Salmonella spp).	Staff not following Good Hygiene Practices. Contamination from birds.	5	1	5	Following Good Hygienic Practices should prevent the likelihood of contamination. Later steps will eliminate hazards.	No	Follow the work instructions for: -Personnel Hygiene Procedure (iss 11/1/22). -Employee Induction Program (iss 11/1/22).
6. Transport of seaweed in bins to processing factory.	Microbiological growth of bacterial pathogens & viruses.	Time out of temperature control.	5	1	5	Later steps will eliminate hazards.	No.	Transport within 2 hours of harvest (pg 8 of Seaweed production & processing in Connecticut).
7. Receival and weighing of wet seaweed in bins.	Physical contamination	Damaged product from bad handling practices/badly maintained equipment.	4	1	4	Following Good Hygienic Practices should prevent the likelihood of contamination.	No.	Follow the work instruction for: -Maintenance Program (iss 11/1/22).
8. Mince wet seaweed.	Physical contamination	Damaged product from bad handling practices/badly maintained equipment- (metal pieces from badly maintained mincer blades& cross contamination from previous allergenic material).	5	1	5	Following Good Hygienic Practices should prevent the likelihood of contamination.	No.	Only use trained personnel. Follow the work instruction for: -Maintenance Program (iss 11/1/22). -Allergen Program (iss 11/1/22).

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								-Cleaning program (iss 11/1/22).
	Allergen cross contamination.	Residues of sodium meta-biphosphate, from cleaning process.	4	2	8	Following Good Hygienic Practices should prevent the likelihood of contamination.		Follow the work instruction for: -Cleaning program (iss 11/1/22).
9. Load minced seaweed onto trays.	Microbial contamination (Staphylococcus aureus).	Staff not following Good Hygiene Practices.	5	1	5	Following Good Hygienic Practices should prevent the likelihood of contamination. Later steps will eliminate hazards.	No	Follow the work instructions for: -Personnel Hygiene Procedure (iss 11/1/22). -Employee Induction Program (iss 11/1/22). -Good food handling practices (iss 11/1/22).
10. Dry seaweed.	Microbiological survival leading to contamination of the final product which may lead to toxin production.	Seaweed not dried for long enough or hot enough.	5	2	10	Contaminated product entering production could affect all product and cannot be controlled at a later step.	CCP- Drying temperature (50C for 6 hours) and aW (0.85) of finished product.	Only trained personnel. Follow the work instructions for: -Drying Process Procedure (iss 11/1/22).
11. Dried seaweed pellets packed into airtight containers for storage.	Microbial contamination (Staphylococcus aureus).	Contamination with pathogens through poor handling practices & contaminated packaging.	5	1	5	Following Good Hygienic Practices should prevent the likelihood of contamination.	No	Follow the work instructions for: -Personnel Hygiene Procedure (iss 11/1/22). -Employee Induction Program (iss 11/1/22). -Approved Supplier Program (iss 11/1/22). -Good food handling practices (iss 11/1/22).
	Microbial growth (Staphylococcus aureus).	Poor storage conditions allow the water activity of the	5	2	10	Contaminated product cannot be controlled at a later step.	CCP- aW (0.83) of finished product.	aW (0.83) of finished product (pg 11 of Seaweed production &

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		product to rise and any bacteria present to grow.						processing in Connecticut.
	Physical contamination.	From contaminated packaging and incorrect handling.	4	1	4	Following Good Hygienic Practices should prevent the likelihood of contamination.	No	Air tight containers. Follow the work instruction for: -Maintenance Program (iss 11/1/22). -Approved Supplier Program (iss 11/1/22).
12. Dried seaweed pellets sold as bulk ingredient for further food processing.	Microbial growth (Staphylococcus aureus).	Poor storage conditions allow the water activity of the product to rise and any bacteria present to grow.	5	2	10	Contaminated product cannot be controlled at a later step.	CCP- aW (0.83) of finished product.	aW (0.83) of finished product (pg 11 of Seaweed production & processing in Connecticut. Air tight containers.



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HACCP TABLE

CCP	Hazard(s)	Control Measure(s)	Critical Limit(s)	Monitoring Procedure(s)	Corrective Action(s)	Record(s)
Steps 1 & 2 Seaweed growing.	Microbiological contamination of bacterial pathogens & viruses from seawater and mineral feed.	Only use filtered clean seawater for growing tanks. Microbiological quality of mineral feed used.	Sea water pumped from river bottom at high tide then filtered (less than 0.1 micron) & salinity (25 parts per thousand) measured prior to use. Reverse osmosis undertaken on mineral feed by approved supplier.	What: -Correct filter in use. -Filter in use is intact. -Salinity level. -Mineral feed supplied by approved supplier with correct documentation. When: At each intake of seawater/feed, prior to use of seawater/feed. Where: Water/feed storage tanks. Who: Farm manager. Record: Product Assessment Form 006.	Address: Isolate and identify all feed/water stored since the last correct critical limit was measured. Correct: Treat water prior to release back to the river. Return feed to supplier. Prevent: Re train staff on critical limits. Farm manager to review approved supplier process and water monitoring process. Record: Corrective Action Report Form 005.	Product Assessment Form 006. Staff Training Form 004. Corrective Action Report Form 005 Approved supplier list, product specification and product lab result.

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CCP	Hazard(s)	Control Measure(s)	Critical Limit(s)	Monitoring Procedure(s)	Corrective Action(s)	Record(s)
Step 10 Dry seaweed	Microbiological survival leading to contamination of the final product which may lead to toxin production.	Drying temperature (50C for 6 hours) and aW (0.83) of finished product.	<p>Cooking time of 6 hours for drying temperature of 50C.</p> <p>A water activity level of Aw 0.85 or below in the finished product.</p>	<p>What: Temperature of the drying process at 50C for 6 hours with a final finished product water activity.</p> <p>When: Every production batch.</p> <p>Where: Drying room.</p> <p>Who: Processing manager.</p> <p>Record: Product Assessment Form 006.</p>	<p>Address: Isolate and identify all products dried since last correct test result.</p> <p>Correct: Adjust temperature levels immediately. Keep drying for longer until product meets required water activity. Increase monitoring frequency. Dry all product since last correct check.</p> <p>Prevent: Retrain staff & keep equipment well maintained.</p> <p>Record: Corrective Action Report Form 005.</p>	<p>Product Assessment Form 006.</p> <p>Staff Training Form 004.</p> <p>Corrective Action Report Form 005</p>
Step 11 & 12 Dried seaweed pellets packed into airtight containers for storage &	Microbial growth (Staphylococcus aureus).	aW (0.83) of finished product.	A water activity level of Aw 0.83 or below in the finished product.	<p>What: moisture content of finished product.</p> <p>When: Every production batch prior to despatch.</p> <p>Where: Packing room.</p>	<p>Address: Isolate and identify all products dried since last correct test result.</p> <p>Correct: Re-dry product until product meets required water activity.</p>	<p>Product Assessment Form 006.</p> <p>Staff Training Form 004</p>

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during transport.				Who: Processing manager. Record: Product Assessment Form 006.	Prevent: Retrain staff. Record: Corrective Action Report Form 005	Corrective Action Report Form 005
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VERIFICATION SCHEDULE

Activity	Description	Frequency	Responsibility	Records
Review monitoring and corrective action records	All production records to be checked to ensure system is followed and limits adhered to.	Weekly	Farm manager & Processing Manager.	Completed forms (records)
Management Review meeting.	Review the outcomes of food safety objectives, outcomes and findings from all other reviews including but not limited to: internal audits, customer complaints, CCP monitoring records, lab results, trace checks & mock recalls, HACCP review, swab results, shelf life tests, staff training, approved suppliers & label reviews.	Annually	Farm manager & Processing Manager & HACCP team.	Meeting minutes and attached records.
Verify flow chart	Follow flow chart when the product is being packed	During internal audits every 6 months	HACCP Team	Updated flowchart-HACCP system.
Review hazards	HACCP team reviews hazards.	Once/year or after changes/outbreaks.	HACCP Team	Hazards Analysis Report
Validate critical limits	Check that critical limits are still appropriate: carry out a literature search.	Once a year	HACCP Team	Scientific papers, Industry guidance notes & recall notices.
Review customer complaints i.e. rejection reports.	Assess any customer complaint/rejection records to highlight any deficiencies of the system	Four times/year	HACCP Team	Management review documentation
Approved supplier review	Review all suppliers (ingredients, packaging, services etc. as required) against performance expectations, customer complaints & service provision. Review current supplier status and upgrade/downgrade as required.	Annually	Farm manager & Processing Manager & HACCP team.	Completed records: Approved supplier list & supplier review assessment record.

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Activity	Description	Frequency	Responsibility	Records
Product label and specification review.	Assess all product specification and labels against legal requirements for market destination for legal compliance including but not limited to: ingredient list, allergen labelling, weights & measures, product claims, country of origin statements.....	Annually	Production manager & HACCP team.	Completed records: Product specification & label register/list & review assessment record.
Shelf-life validation using retained samples	Retained sample full internal assessment.	Once a year for each product type sold.	HACCP Team leader	Completed forms (records)
Microbiological testing of finished products	E.coli (>100 cfu), Yeast (100cfu) & mould (100 cfu), Listeria mono ND, Salmonella ND, Staph <100cfu & Vibrio spp <100 per cfu/gm.	Once a year	HACCP Team leader	Lab reports
Chemical testing of seaweed	Inorganic arsenic (1 mg/kg)	Once a season	HACCP Team leader	Lab reports
Calibrate testing equipment	Test all equipment that measure critical limits: scales, pH meter, thermometer, etc.	As per calibration schedule	Farm manager & Processing Manager.	Test results & calibration log.
Undertake swabbing of product contact surfaces areas after cleaning to verify the effectiveness of the cleaning process (microbiological/allergenic as relevant).	Swab product contact surfaces (i.e. tables & equipment) after cleaning using (as relevant) ATP, allergen swabs (ie gluten/eggs/dairy...) or/and micro biological swabs (ie TPC/coliforms/yeast/moulds) using documented method and either send to lab for processing or review results onsite.	Every six months.	HACCP team leader.	Lab results.
Review staff training	To review staff training needs in the area of HACCP/Food safety & to ensure training records are updated.	Every six months.	Farm manager & Processing Manager.	Staff training records
Internal audit for the whole management and food safety system against certificate std & relevant regulatory requirements.	Verify activities comply with documented requirements. Identify areas of poor performance and opportunities for improvement	Every six months.	HACCP Team leader	Audit report

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Activity	Description	Frequency	Responsibility	Records
GHP site audits	Site, staff and equipment review against food safety requirements and regulations.	Monthly	HACCP team member.	Audit report
Mock recall and product trace check	Product traced from end customer back to growing tank and date with all production and testing and staff identified.	Once a year	HACCP Team leader	Mock recall report.



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VALIDATION TABLE

Potential Hazard	Critical Limits	References
Inorganic arsenic	Inorganic arsenic in seaweed is 1 mg/kg.	Food Standards Code Schedule 19 Maximum levels of contaminants and natural toxicants: specifically includes seaweed & lists maximum levels for inorganic arsenic. https://www.legislation.gov.au/Series/F2015L00454
Iodine	maximum level (1000 mg/kg) of iodine in imported brown seaweed of the Phaeophyceae class in October 2010 at the Australian border.	There is currently no permitted maximum level in the Australia New Zealand Food Standards Code for naturally occurring iodine in brown seaweed Brown seaweed and Iodine.pdf (foodstandards.gov.au) The species used in this process is not a brown seaweed and is not imported.
Heavy metal limits	Cadmium <0.005 & Lead: <0.02.	FSANZ: 1.4.1 Contaminants and natural toxicants cross ref to Schedule 19 Maximum levels of contaminants and natural toxicants.
Microbial growth: <i>Vibrio spp</i>	Limits to stop pathogen growth: <ul style="list-style-type: none">Aw 0.94 or below	US FDA Seafood Hazards Guide Appendix 4 Bacterial Pathogen growth and inactivation (June 2021).
Microbial growth: <i>Salmonella spp</i>	Limits to stop pathogen growth <ul style="list-style-type: none">Aw 0.93 or below	AIFST (NSW Branch) (1997), Foodborne Microorganisms of Public Health Significance, Food Microbiology Group. US FDA Seafood Hazards Guide Appendix 4 Bacterial Pathogen growth and inactivation (June 2021).

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Potential Hazard	Critical Limits	References
Microbial growth and toxin production. <i>S.aureus</i>	Limits to stop pathogen growth and toxin production: <ul style="list-style-type: none"> Aw 0.83 or below 	AIFST (NSW Branch) (1997), Foodborne Microorganisms of Public Health Significance, Food Microbiology Group. US FDA Seafood Hazards Guide Appendix 4 Bacterial Pathogen growth and inactivation (June 2021).
Microbial growth: <i>E.coli</i>	Limits to stop pathogen growth: <ul style="list-style-type: none"> Aw 0.95 or below. 	AIFST (NSW Branch) (1997), Foodborne Microorganisms of Public Health Significance, Food Microbiology Group. US FDA Seafood Hazards Guide Appendix 4 Bacterial Pathogen growth and inactivation (June 2021).
Microbial growth: <i>Shigella.</i>	Limits to stop pathogen growth: <ul style="list-style-type: none"> Aw 0.96 or below. 	US FDA Seafood Hazards Guide Appendix 4 Bacterial Pathogen growth and inactivation (June 2021).
Pathogen growth: Hepatitis A virus.	Limits to stop pathogen growth: Cook for 1 minute at 85C.	https://www.cdc.gov/hepatitis/hav/havfaq.htm
Pathogen growth: Norovirus	Limits to stop pathogen growth: Cook for 1 minute above 65C.	https://www.cdc.gov/norovirus/about/prevention.html

Further reference materials:

-Reference: NSW Government, NSW Food Authority, October 2010, Inorganic arsenic in seaweed and certain fish, NSW/FA/CP043/1102,
https://www.foodauthority.nsw.gov.au/sites/default/files/_Documents/scienceandtechnical/inorganic_arsenic_seaweed_seafood.pdf (28/6/2021).

-FSANZ, Compendium of Microbiological Criteria for Food, September 2018.
https://www.foodstandards.gov.au/publications/Documents/Compendium%20of%20Microbiological%20Criteria/Compendium_revised-Sep%202018.pdf

-Seaweed Production and Processing in Connecticut: A Guide to Understanding and Controlling Potential Food Safety Hazards
https://seagrant.uconn.edu/wp-content/uploads/sites/1985/2020/01/Seaweed-Hazards-Guide_Jan2020_accessible.pdf
<https://seagrant.uconn.edu/2020/02/25/1st-food-safety-guide-for-seaweed-may-help-product-advance/>

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