SAPIENZA
UNIVERSITÀ DI ROMA

Processi fermentativi nelle strategie "zero-waste":

dagli alimenti funzionali alle bioplastiche

Carlo Giuseppe Rizzello

Sapienza University of Rome, Italy

carlogiuseppe.rizzello@uniroma1.it

Origin and fate of the agri-food side-streams

Discarded during supply chain, at any stage:

- Production
- Processing
- Distribution
- Retail
- Consumption

By-products, surplus, defective/unsold/expired products…

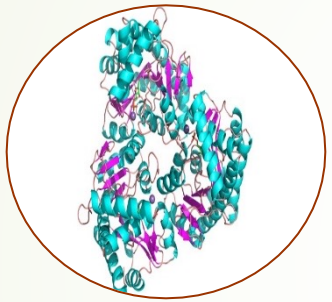
edible/not edible side-streams

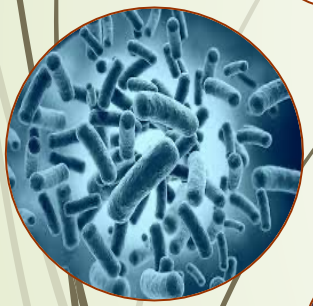
compost – biogas/bioethanol - feed

Agri-food side-streams UPCYCLING

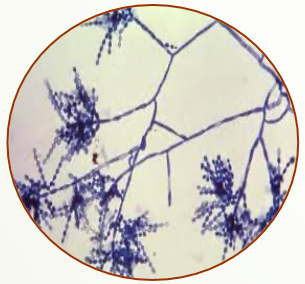
very high organic load

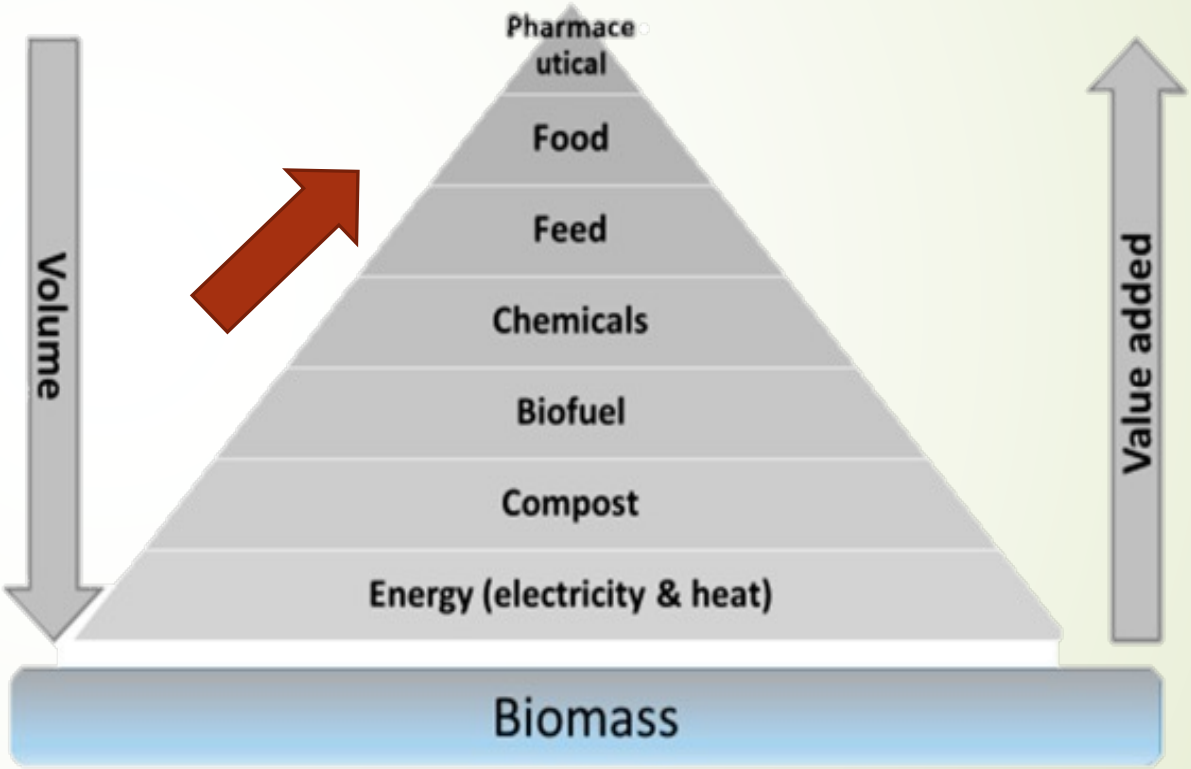
economic loss





BIOPROCESSING





Department of Environmental Biology, Sapienza University of Rome, Italy

Recycling and valorisation through bioprocessing

a) use as substrate for microbial growth

microbial biomasses

- probiotics
- starters (fermented food)
- biocontrol/biopreservation

metabolites (biorefinery)

natural or recombinant microrganisms

- Bioplastics
- Biofungicides
- **Functional compounds**
  - **GABA**
  - **Bioactive peptides**
  - **Equol**
- Compounds for pharmaceutical and cosmetic uses

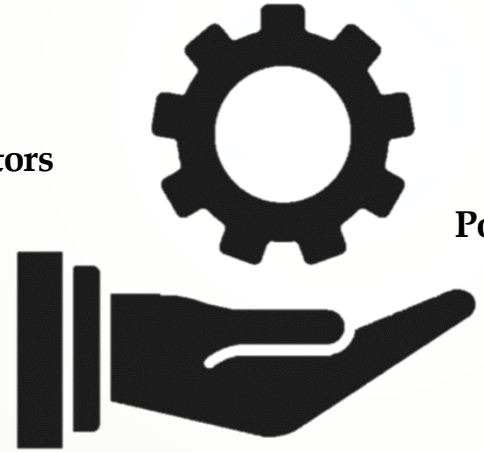
Recycling and valorisation through bioprocessing

b) food ingredients

Poor technological properties

Poor sensory properties

Antinutritional factors



Poor microbiological properties

Dietary fibers
Proteins
Phenolic and other functional compounds
Minerals

Upcycling side streams into food ingredients

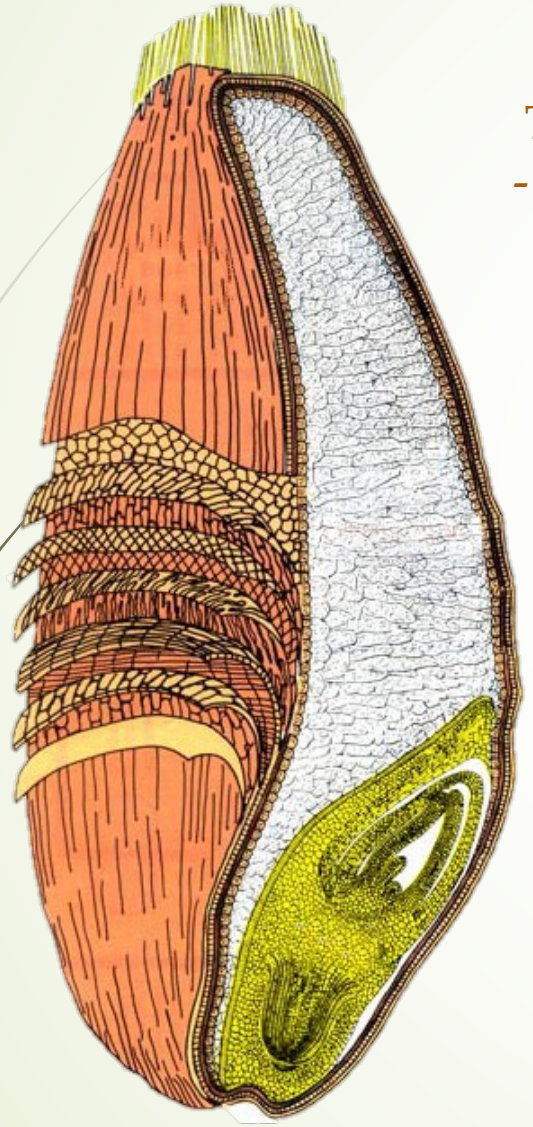
Development of the "strategy"

- *Control plan for the side-streams supply chain*
- *pre-process conditions (thermal treatments, wet milling)*
- **selection of starter microrganisms and enzymes**
- *set-up of the biotechnological protocol*
- *optimization of the process parameters*
- *stabilization conditions*

Agri-food side-streams

fruits and vegetables	*post-harvest losses, unsold, peels*
cereal industry	*surplus wasted bread* *milling by-products* *brewer's spent grain*
dairy sector	*whey* *ricotta cheese exhausted whey*
oenological sector	*grape pomace*

Milling by-products - *Wheat bran-*



Technological issues

- **Consumers' acceptability**

Source of:

- Fibers
- Minerals
- Proteins
- Phenols

Antinutritional factors

- Phytic acid

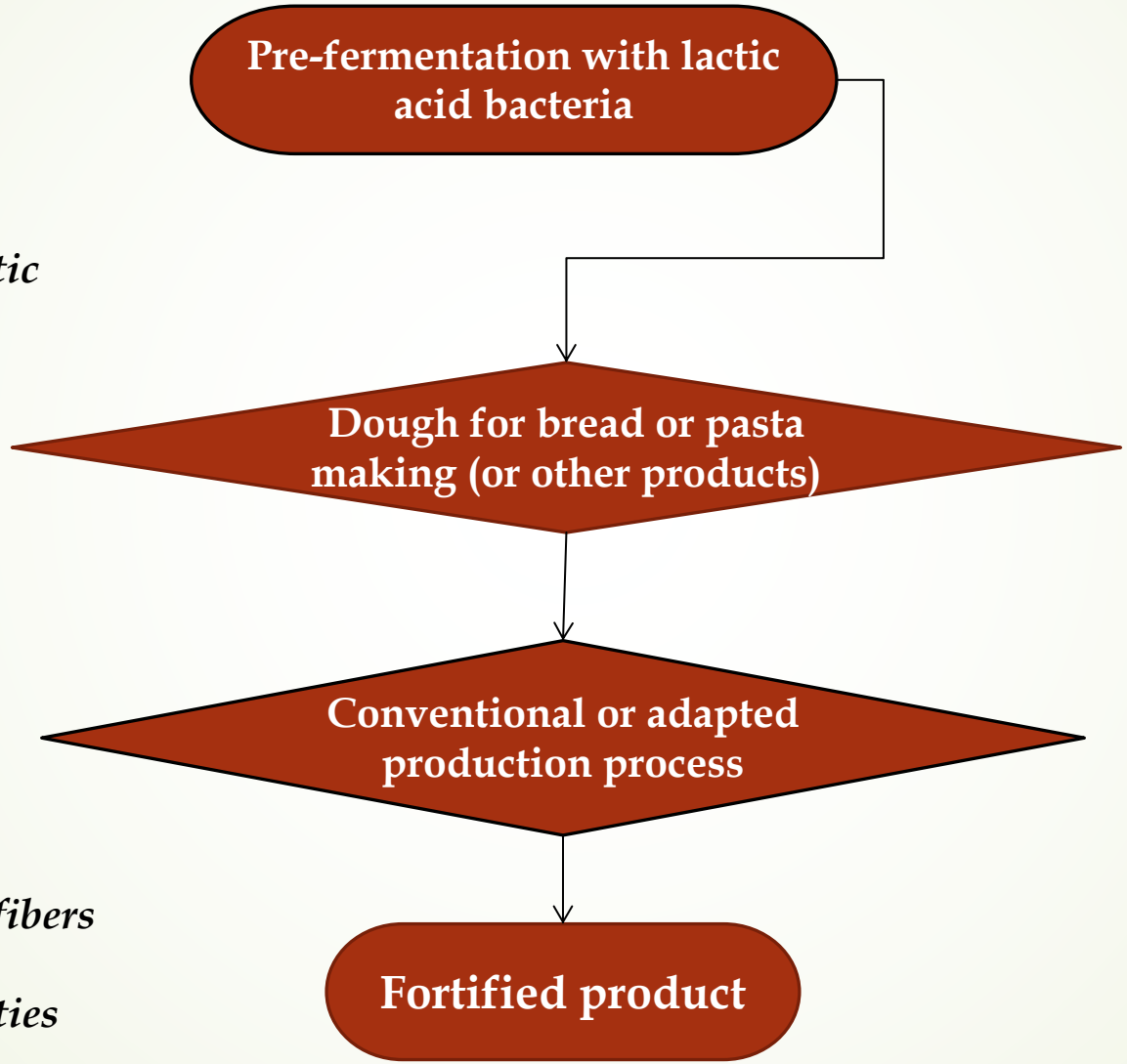
Effects of sourdough fermentation on dietary fibre

- Bread with 10 % of fermented bran had the best **sensory properties** (Eiman et al., 2008)
- Most suitable technology for the manufacture of wholemeal rye (Katina *et al*., 2005)
- Controls the endogenous xylanase activity and the subsequent solubilisation of arabinoxylans (Katina *et al*., 2012)

- Without sourdough wholemeal rye or wheat-rye flour mixes are very difficult to process (Katina and Poutanen 2012)
- Improved the loaf **volume** and crumb softness of high-fibre wheat breads (Katina et al., 2012; Salmenkallio-Marttila et al., 2001; Katina et al., 2006)
- Improves flavour, **texture** and shelf life of whole grain rye breads (Katina and Poutanen 2012)

How to use «non-wheat» ingredients

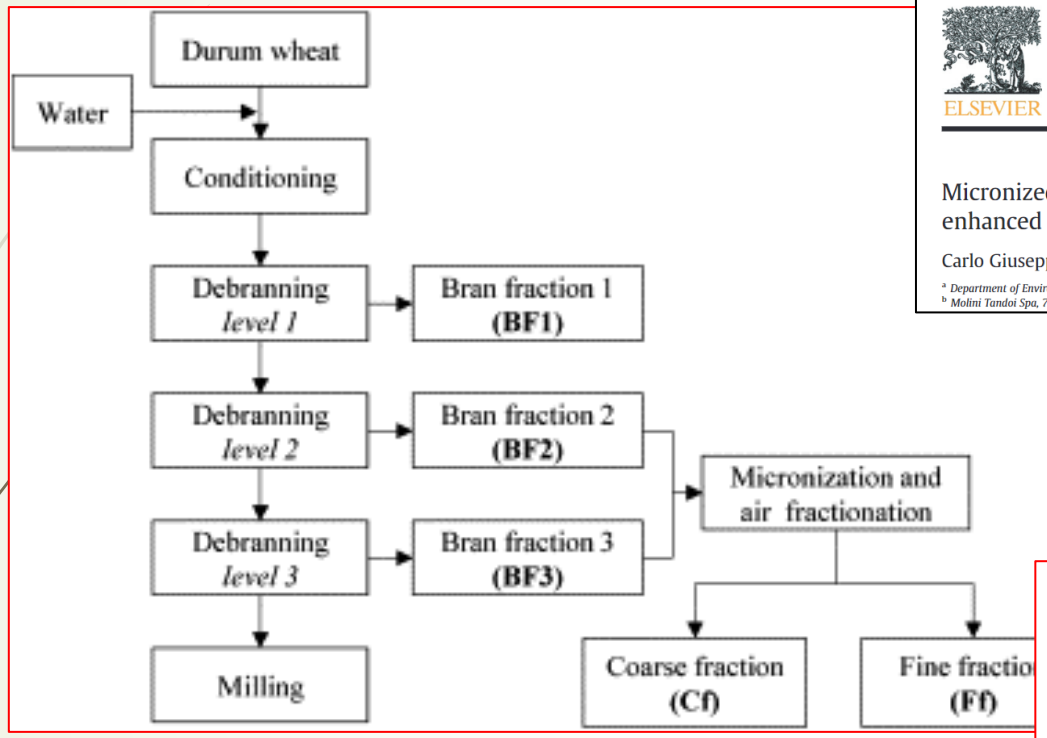
- *Promotion of the phytic acid degradation*



- *Increase of the dietary fibers*
- *Decrease of the GI*
- *Texture/sensory properties*

Technological options

1- Debranning,
2- micronization and air fractionation



Food Research International 46 (2012) 304–313

Contents lists available at SciVerse ScienceDirect

Food Research International

journal homepage: www.elsevier.com/locate/foodres

Micronized by-products from debranned durum wheat and sourdough fermentation enhanced the nutritional, textural and sensory features of bread

Carlo Giuseppe Rizzello [a], Rossana Coda [a,*], Francesco Mazzacane [a], Davide Minervini [b], Marco Gobbetti [a]

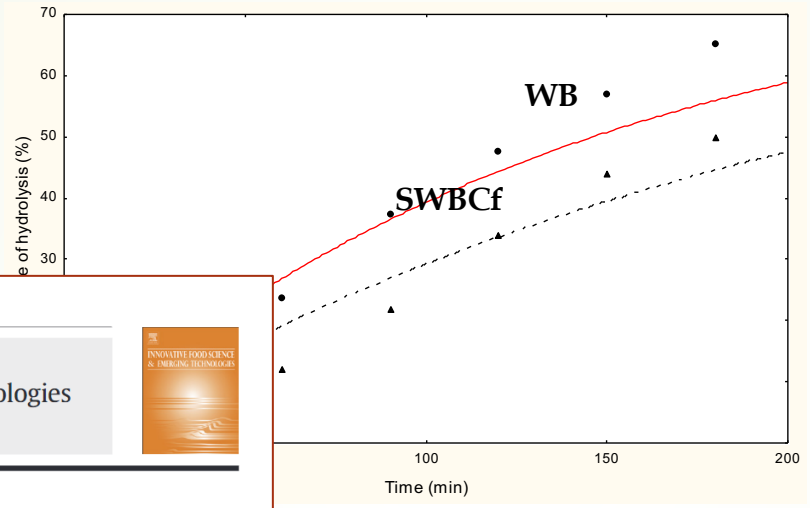
[a] Department of Environmental and Agro-Forestry Biology and Chemistry, University of Bari, 70125 Bari, Italy
[b] Molini Tandoi Spa, 70033 Corato, Bari, Italy

	Cf	Ff
Chemical and physical characteristics		
pH	$6.7 \pm 0.2^{n.s.}$	$6.7 \pm 0.1^{n.s.}$
TTA	13.7 ± 0.3^{b}	16.3 ± 0.1^{a}
Moisture (%)	$14.0 \pm 0.3^{n.s.}$	$14.0 \pm 0.1^{n.s.}$
Ash (% d.m.)	5.7 ± 0.2^{b}	7.1 ± 0.1^{a}
Total dietary fiber (% d.m.)	60.1 ± 0.8^{a}	38.2 ± 0.5^{b}
Starch (% d.m.)	5.1 ± 0.8^{b}	9.3 ± 0.8^{a}
Fat (% d.m.)	6.5 ± 0.2^{b}	9.0 ± 0.2^{a}
Protein (% d.m.)	8.0 ± 0.1^{b}	19.0 ± 0.3^{a}

Sourdough applications: pre-treatment of bran and micronized bran

5- Micronization and effect of the particle size

Rate of starch hydrolysis



Innovative Food Science and Emerging Technologies 25 (2014) 19–27

Contents lists available at ScienceDirect

Innovative Food Science and Emerging Technologies

journal homepage: www.elsevier.com/locate/ifset

Effect of bioprocessing and particle size on the nutritional properties of wheat bran fractions

Rossana Coda [a,*], Carlo Giuseppe Rizzello [b], José Antonio Curiel [b], Kaisa Poutanen [a,c], Kati Katina [a]

[a] VTT, Tietotie 2, 02044 VTT, Finland
[b] Department of Soil, Plant and Food Sciences, University of Bari, 70126 Bari, Italy
[c] Department of Clinical Nutrition, University of Eastern Finland, Kuopio Campus, P.O. Box 1627, FIN-70211 Kuopio, Finland

Food Research International 46 (2012) 304–313

Contents lists available at SciVerse ScienceDirect

Food Research International

journal homepage: www.elsevier.com/locate/foodres

Micronized by-products from debranned durum wheat and sourdough fermentation enhanced the nutritional, textural and sensory features of bread

Carlo Giuseppe Rizzello [a], Rossana Coda [a,*], Francesco Mazzacane [a], Davide Minervini [b], Marco Gobbetti [a]

[a] Department of Environmental and Agro-Forestry Biology and Chemistry, University of Bari, 70125 Bari, Italy
[b] Molini Tandoi Spa, 70033 Corato, Bari, Italy

Fermented bran as bread ingredient:

- -High concentration of functional compounds (phenols and dietary fibre),
- -Decrease of HI
- -Improving of the textural properties,
- Improving of sensory characteristics.
- Increased protein bioavailability (use of xylanases) and digestibility

Panel test

	WB	SWB	WBCf	SWBCf
Elasticity	7.5	7.8	6.3	7.8
Crumb color	3.8	4.5	7.3	7.6
Crust color	4.3	6.3	6.5	7.8
Acid flavor	1.8	4.8	3.0	5.0
Acid taste	1.5	5.3	2.8	5.8
Sweetness	4.7	4.7	5.7	5.0
Dryness	4.3	4.0	5.0	3.8
Taste	6.3	7.0	7.3	7.8
Salty	5.3	5.7	5.7	6.7

Department of Environmental Biology, Sapienza University of Rome, Italy

Technological options

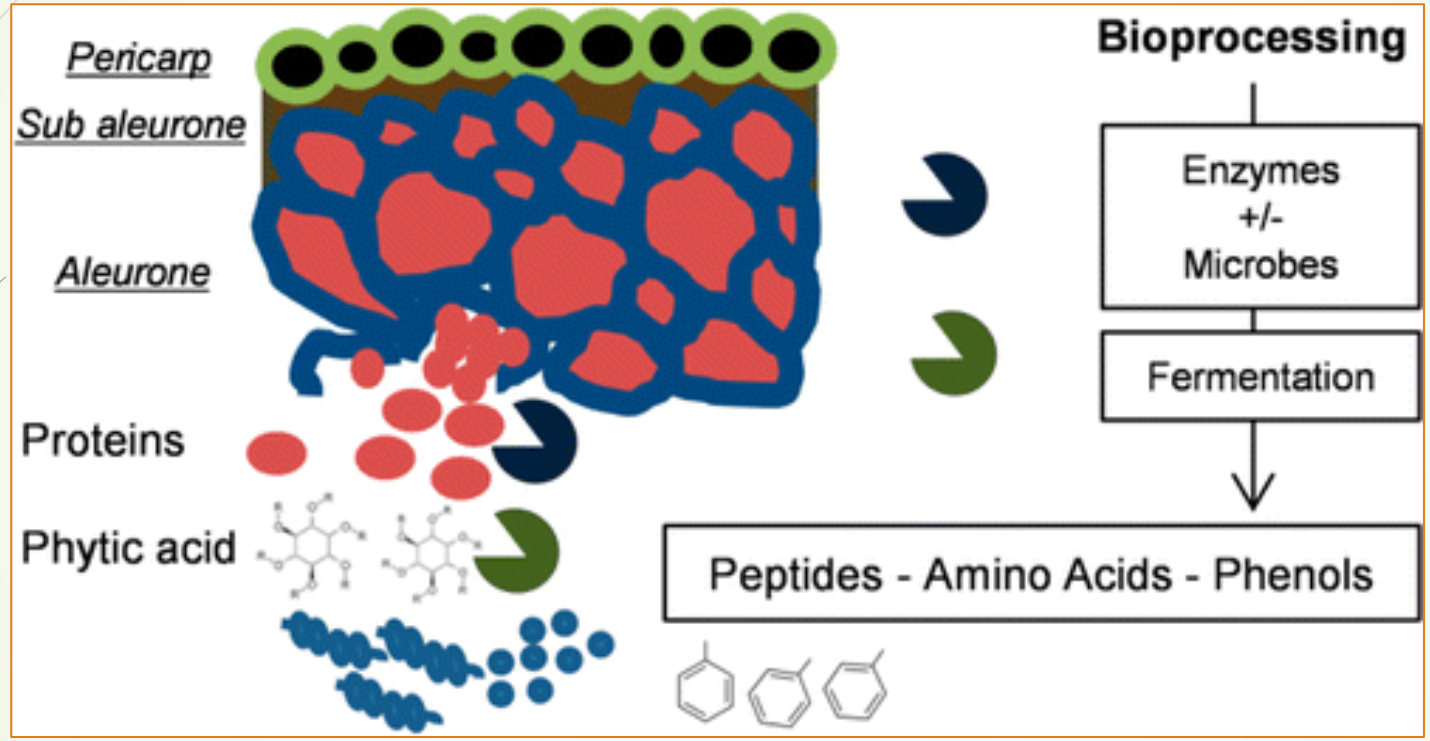
3- Enzymes

JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY
Article
pubs.acs.org/JAFC

Impact of Enzymatic and Microbial Bioprocessing on Protein Modification and Nutritional Properties of Wheat Bran

Elisa Arte,[†] Carlo G. Rizzello,[‡] Michela Verni,[‡] Emilia Nordlund,[§] Kati Katina,[†] and Rossana Coda*[,†]

[†]Department of Food and Environmental Sciences, University of Helsinki, P.O. Box 27, FI−00014 Helsinki, Finland
[‡]Dipartimento di Scienze del Suolo, della Pianta e degli Alimenti, University of Bari, Via G. Amendola 165/a, Bari 70126, Italy
[§]VTT Technical Research Centre of Finland, P.O. Box 1000, FI-02044 VTT Espoo, Finland



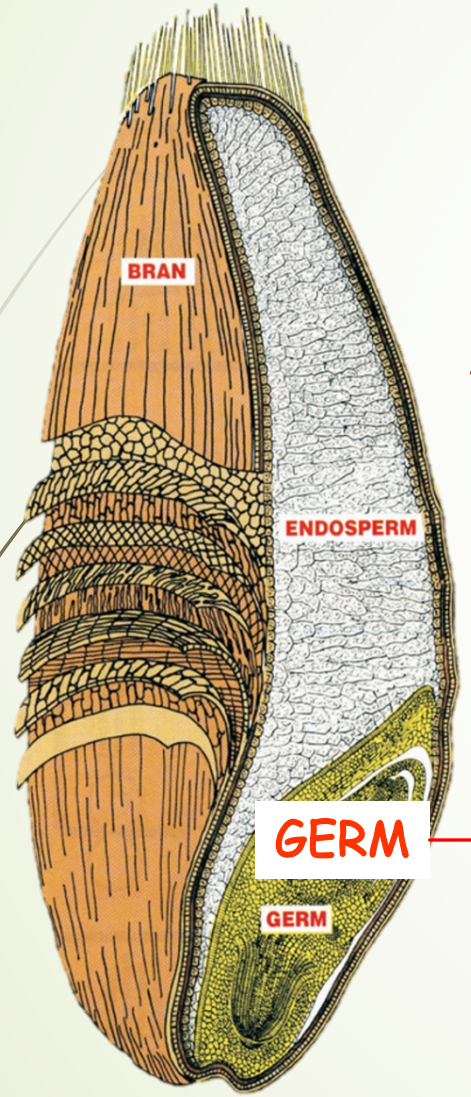
ELSEVIER
Available online at www.sciencedirect.com
ScienceDirect
Current Opinion in Food Science

Bran bioprocessing for enhanced functional properties

Rossana Coda[1], Kati Katina[1] and Carlo G Rizzello[2]

CrossMark

Sourdough applications: pre-treatment of wheat germ



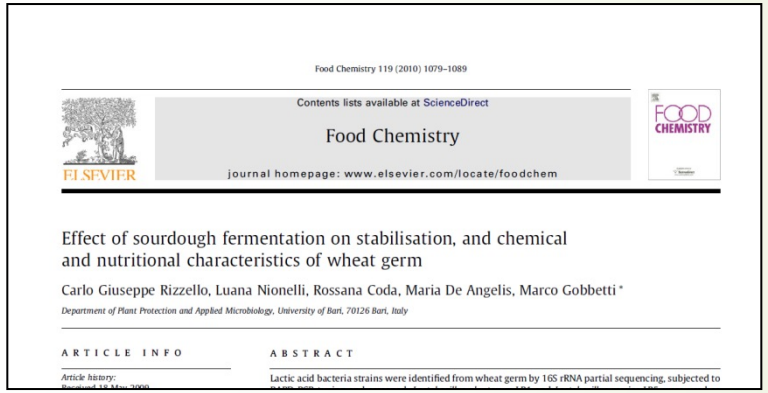
- ✓ α-Tocopherol
- ✓ Vitamins B
- ✓ Dietary fibre
- ✓ Minerals
- ✓ Proteins
- ✓ Phytochemicals (flavonoids, sterols,…)
- ✓ Unsatured fatty acids

Antinutritional factors

- ✓ Raffinose
- ✓ Phytic acid
- ✓ Wheat germ agglutinin

- Wheat germ-

- **Technological issues**
- **Storage issues**
- **Consumers' acceptability**



Food Chemistry 119 (2010) 1079–1089

Contents lists available at ScienceDirect

Food Chemistry

journal homepage: www.elsevier.com/locate/foodchem

Effect of sourdough fermentation on stabilisation, and chemical and nutritional characteristics of wheat germ

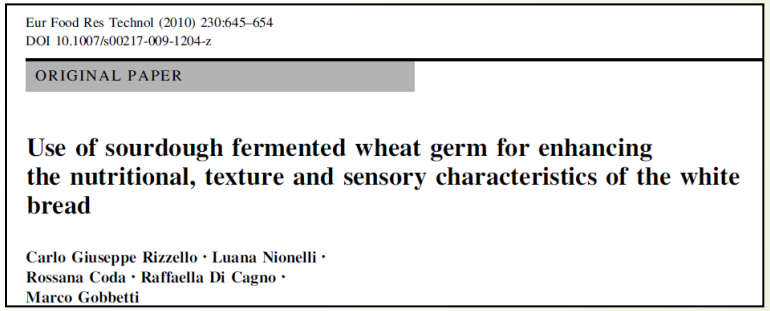
Carlo Giuseppe Rizzello, Luana Nionelli, Rossana Coda, Maria De Angelis, Marco Gobbetti *

Department of Plant Protection and Applied Microbiology, University of Bari, 70126 Bari, Italy

ARTICLE INFO

ABSTRACT

Lactic acid bacteria strains were identified from wheat germ by 16S rRNA partial sequencing, subjected to



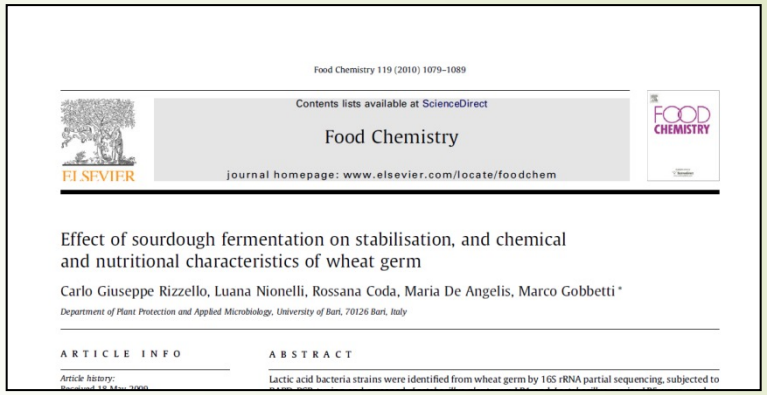
Eur Food Res Technol (2010) 230:645–654
DOI 10.1007/s00217-009-1204-z

ORIGINAL PAPER

Use of sourdough fermented wheat germ for enhancing the nutritional, texture and sensory characteristics of the white bread

Carlo Giuseppe Rizzello · Luana Nionelli · Rossana Coda · Raffaella Di Cagno · Marco Gobbetti

Pre-fermentation of wheat germ with selected lactic acid bacteria


Food Chemistry 119 (2010) 1079–1089

Contents lists available at ScienceDirect

Food Chemistry

journal homepage: www.elsevier.com/locate/foodchem

Effect of sourdough fermentation on stabilisation, and chemical and nutritional characteristics of wheat germ

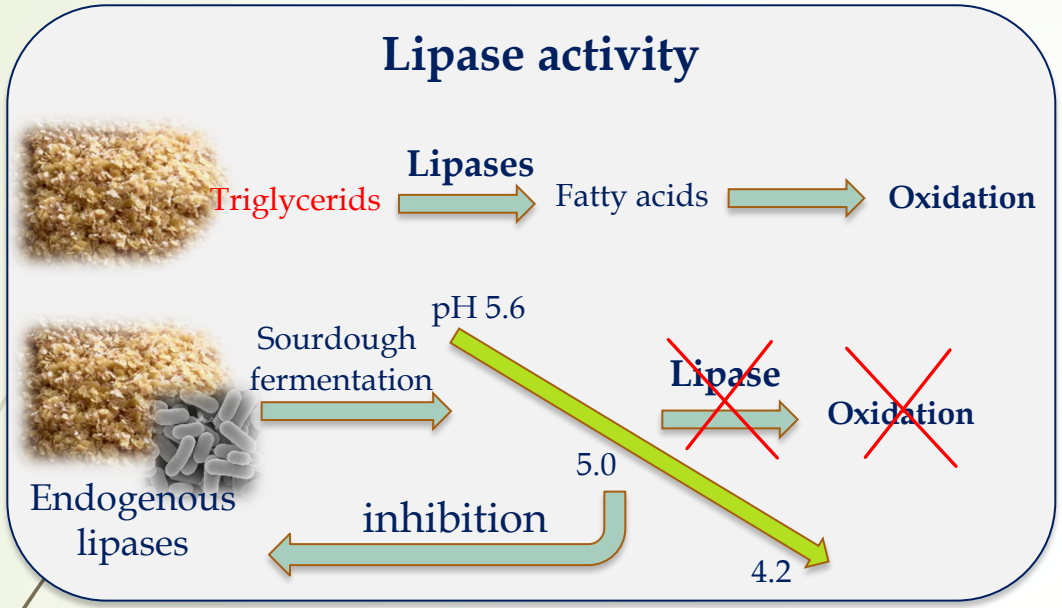
Carlo Giuseppe Rizzello, Luana Nionelli, Rossana Coda, Maria De Angelis, Marco Gobbetti *

Department of Plant Protection and Applied Microbiology, University of Bari, 70126 Bari, Italy

ARTICLE INFO

ABSTRACT

Lactic acid bacteria strains were identified from wheat germ by 16S rRNA partial sequencing, subjected to

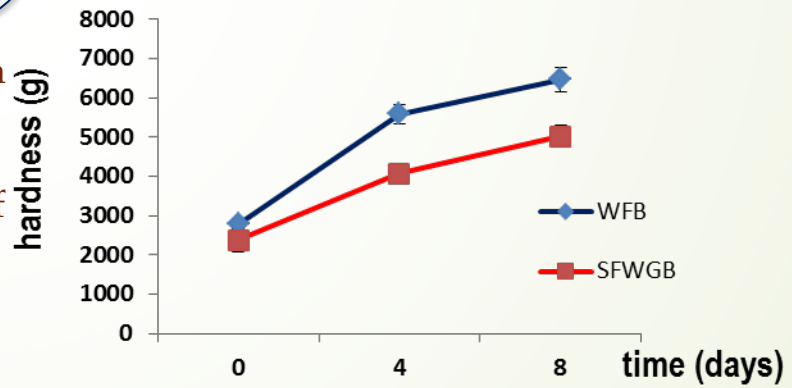


- ✓ Decrease of the lipase activity (2.6 times lower than control)
- ✓ 40 days monitoring of hexanal and volatile markers of lipidic oxidation

SFWG as bread ingredient

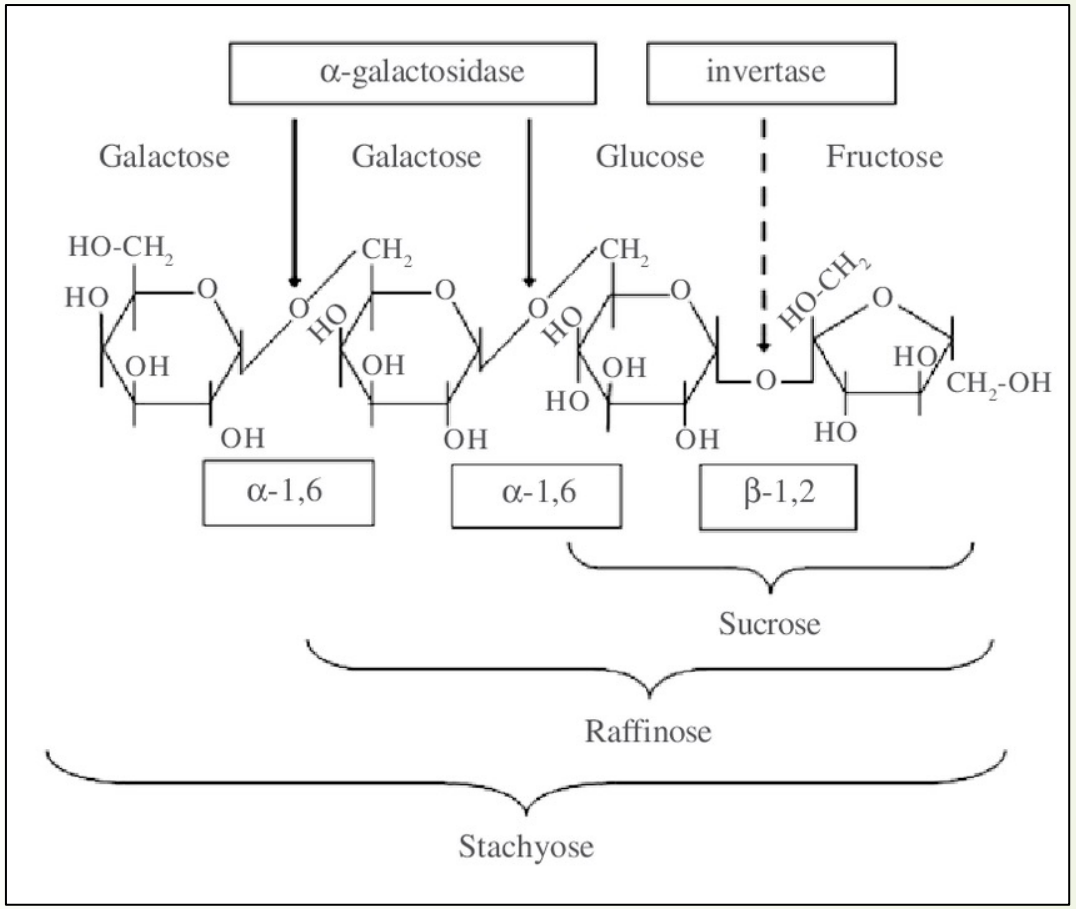
(4% on flour weight)

- ✓ Specific volume **+ 16-18%**
- ✓ Increase of the structural features; firmness delay



Raffinose (and RFO) degradation

- Most mammals, including man, lack pancreatic alpha-galactosidase (alpha-Gal), which is necessary for the hydrolysis of these sugars.
- RFO can be fermented by gas-producing microorganisms present in the cecum and large intestine, which in turn can induce flatulence and other gastrointestinal disorders in sensitive individuals
- the use of microorganisms expressing alpha-Gal is a promising solution to the elimination of NDO before they reach the large intestine



Leblanc et al., 2004

Pre-fermentation of milling by-products: applications

Journal of Cereal Science 77 (2017) 235–242

Contents lists available at ScienceDirect

Journal of Cereal Science

journal homepage: www.elsevier.com/locate/jcs

Use of fermented milling by-products as functional ingredient to develop a low-glycaemic index bread

Erica Pontonio [a], Anna Lorusso [a], Marco Gobbetti [b], Carlo Giuseppe Rizzello [a,*]

vallefiorita®

patent n. 102016000015871
16.2.2016

- Low glycemic index bread
  (**GI *in vivo* 36.9%**)
- **"source of fibers"**
  (6%, w/w)

ORIGINAL RESEARCH ARTICLE

Front. Microbiol., 19 March 2019 | https://doi.org/10.3389/fmicb.2019.00561

Maize Milling By-Products: From Food Wastes to Functional Ingredients Through Lactic Acid Bacteria Fermentation

Erica Pontonio[1]*, Cinzia Dingeo[1], Marco Gobbetti[2] and Carlo Giuseppe Rizzello[1]

[1]Department of Soil, Plant and Food Sciences, University of Bari Aldo Moro, Bari, Italy
[2]Faculty of Science and Technology, Free University of Bozen-Bolzano, Bolzano, Italy

patent n. WO 2021/260543

International Journal of Food Microbiology 313 (2020) 108384

Contents lists available at ScienceDirect

International Journal of Food Microbiology

journal homepage: www.elsevier.com/locate/ijfoodmicro

Brans from hull-less barley, emmer and pigmented wheat varieties: From by-products to bread nutritional improvers using selected lactic acid bacteria and xylanase

Erica Pontonio[a], Cinzia Dingeo[a], Raffaella Di Cagno[b,*], Massimo Blandino[c], Marco Gobbetti[b], Carlo Giuseppe Rizzello[a]

[a] Department of Soil, Plant and Food Science, University of Bari Aldo Moro, 70126 Bari, Italy
[b] Faculty of Science and Technology, Free University of Bozen-Bolzano, 39100 Bolzano, Italy
[c] Department of Agricultural, Forest and Food Sciences, University of Turin, 10095 Grugliasco, Italy

Emmer – barley – pigmented wheat

Use of defatted wheat germ

Table 1
Proximate composition of the defatted wheat germ (DWG).

Chemical composition (g/100 g)	DWG
Moisture	7.00 ± 0.28
Protein (d.m.)[a]	25.20 ± 0.77
Fat (d.m.)	0.51 ± 0.20
Carbohydrates (d.m.)	28.19 ± 1.30
Total dietary fibers (d.m.)	35.44 ± 3.13
Salt (d.m.)	0.02 ± 0.00
Ash (d.m.)	5.05 ± 0.55

LWT - Food Science and Technology 163 (2022) 113566

Contents lists available at ScienceDirect

LWT

journal homepage: www.elsevier.com/locate/lwt

Defatted durum wheat germ to produce type-II and III sourdoughs: Characterization and use as bread ingredient

Giuseppe Perri [a], Marcello Greco Miani [b], Gianfranco Amendolagine [b], Erica Pontonio [a], Carlo Giuseppe Rizzello [c,*]

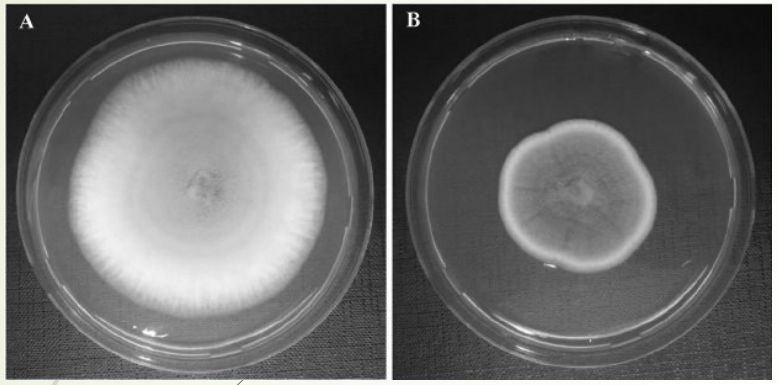
Cell density of lactic acid bacteria (log10 cfu/g), pH, concentration of lactic and acetic acids, fermentation quotient (FQ), total titratable acidity (TTA), phytic acid, raffinose and total free amino acids (TFAA) content, of the fermented defatted wheat germ (fDWG) before (0 h) and after (24 h) fermentation at 30 °C with *L. plantarum* T6B10 and *F. sanfranciscensis* A2S5. Data refer to wet samples (DY 200).

	fDWG	
	0 h	24 h
Lactic acid bacteria (log10 cfu/g)	7.43 ± 0.48^{b}	9.76 ± 0.20^{a}
pH	6.22 ± 0.15^{a}	3.74 ± 0.31^{b}
TTA (ml NaOH)	2.70 ± 0.11^{b}	44.14 ± 2.25^{a}
Lactic acid (mmol/kg)	0.27 ± 0.02^{b}	167.7 ± 9.57^{a}
Acetic acid (mmol/kg)	1.04 ± 0.09^{b}	15.01 ± 1.15^{a}
FQ	0.25 ± 0.02^{b}	11.17 ± 2.50^{a}
TFAA (mg/kg)	1307.61 ± 118^{b}	4268.5 ± 301^{a}
Phytic acid (g/100g)	1.43 ± 0.24^{a}	0.77 ± 0.15^{b}
Raffinose (g/100g)	0.66 ± 0.18^{a}	0.06 ± 0.02^{b}

Casillo GROUP

Department of Environmental Biology, Sapienza University of Rome, Italy

Antifungal organic acids and peptides purified from sourdough fermented wheat germ



Organic acids	Activity
Organic acid mixture[b]	+ + +
Oxalic acid (1.57 mM)	-
Lactic acid (24.3 mM)	±
Formic acid (24.7 mM)	++
Acetic acid (10.8 mM)	±
Citric acid (3.2 mM)	-
Citric acid (18.2 mM)	-
Phenyl lactic acid (0.4 mM)	+
Valeric acid (0.98 mM)	±

Food Chemistry 127 (2011) 952–959

Contents lists available at ScienceDirect

Food Chemistry

journal homepage: www.elsevier.com/locate/foodchem

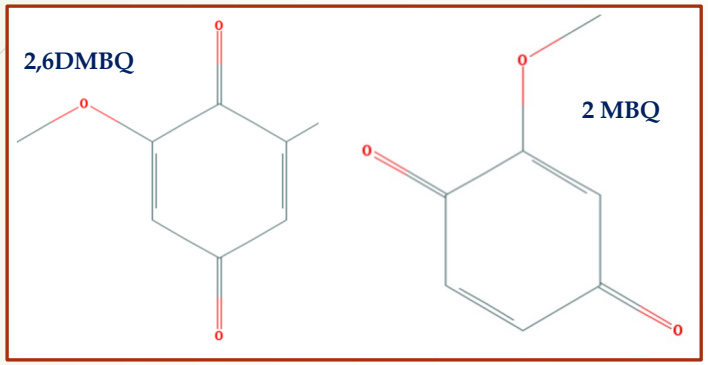
Antifungal activity of sourdough fermented wheat germ used as an ingredient for bread making

Carlo Giuseppe Rizzello, Angela Cassone, Rossana Coda, Marco Gobbetti *

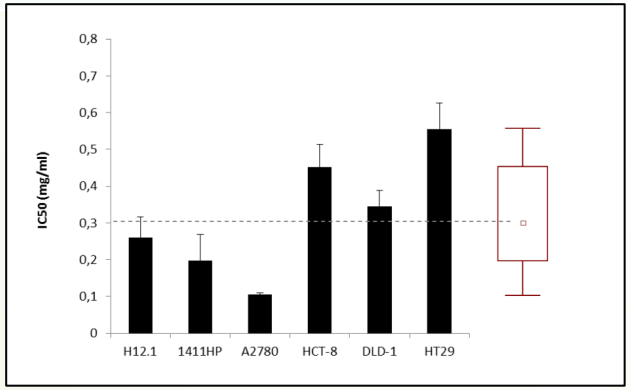
Dipartimento di Biologia e Chimica Agro-Forestale ed Ambientale, University of Bari, 70126 Bari, Italy

Sequence	Source Protein NCBI accession
VLHEPLF	FH4_ORYSJ, Q8H8K7
YNNPIIYVTENGIAEGNN	BGL29_ORYSJ,;
KSLPITEAL	A3C053
ALKAAPSPA	HOX2_ORYSI, Q84U86
AILIIVMLFGR	HKT6_ORYSJ, Q6H501
AAAAVFLSLLAVGHCAAA	EXPB4_ORYSJ,;
DFNATDADADFAGNGVD FNSSDAAVYWGPWTKAR	Q94LR4

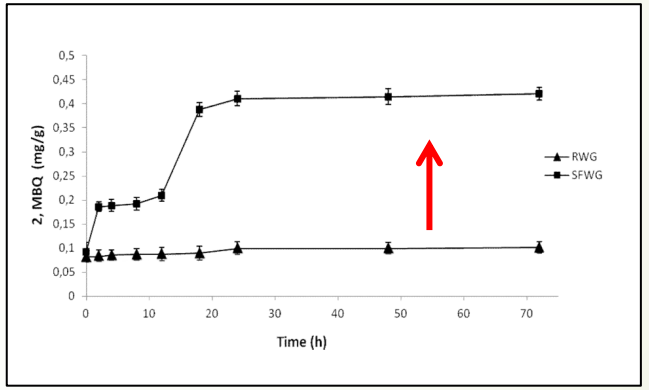
Synthesis of functional compounds during sourdough fermentation of wheat germ



Antiproliferative activity on tumoral human cells (IC_{50})



Kinetics of synthesis



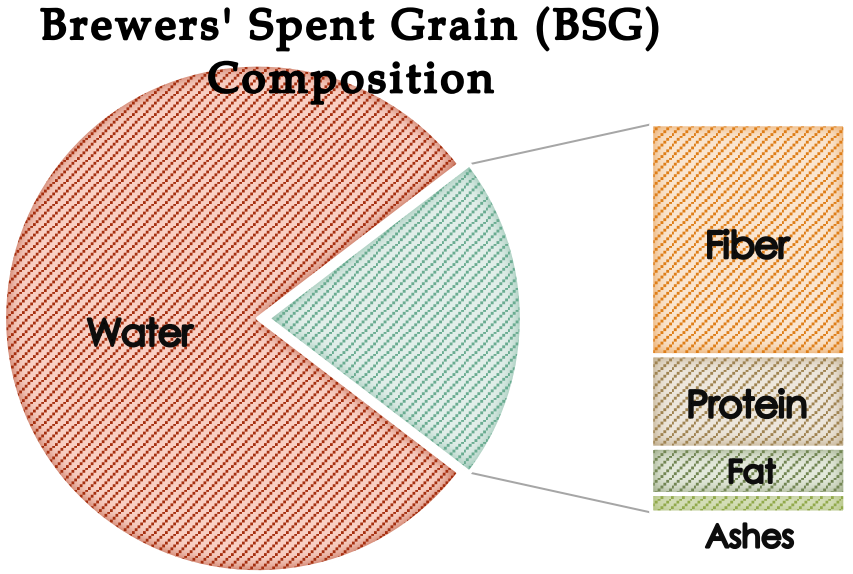
Biotransformation of brewer´s spent grain: increased functionality for novel food applications

70% low-value animal feed (~€35/ton)

10% biogas

20% landfill

Bianco et al., 2020. *Appl. Microbiol. Biotechnol.* 1-18.

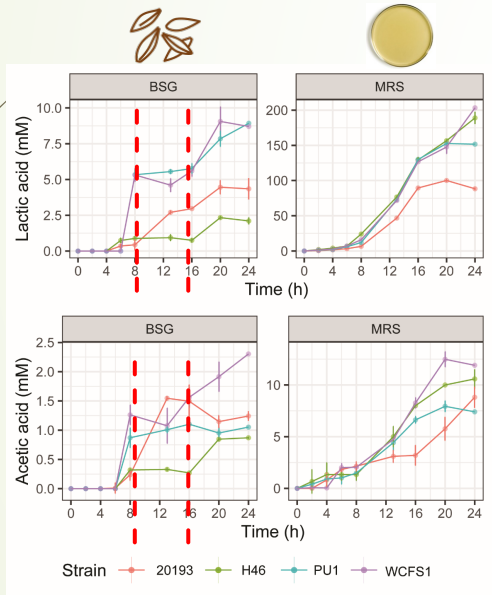


BSG: a by-product with hidden potential, after all…

Department of Environmental Biology, Sapienza University of Rome, Italy

Phenotype switching and gene expression

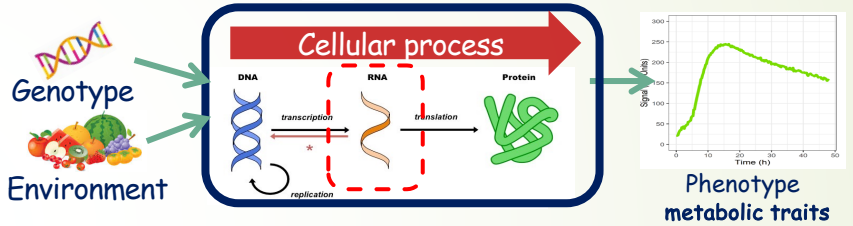
- All strains showed **organic acid** production divided into **two phases** in BSG **(diauxic growth)**.
- **Expression of genes** related to selected substrates that strains consumed more intensely under BSG conditions during the two phases

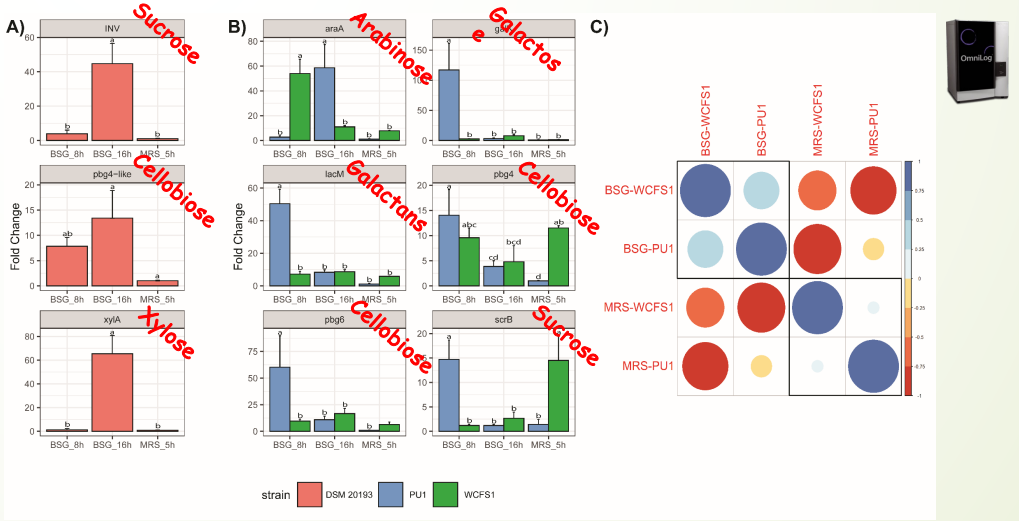


microbial biotechnology
Open Access
Research Article | Open Access

How water-soluble saccharides drive the metabolism of lactic acid bacteria during fermentation of brewers' spent grain

Marta Acin-Albiac, Pasquale Filannino, Rossana Coda, Carlo Giuseppe Rizzello, Marco Gobbetti, Raffaella Di Cagno



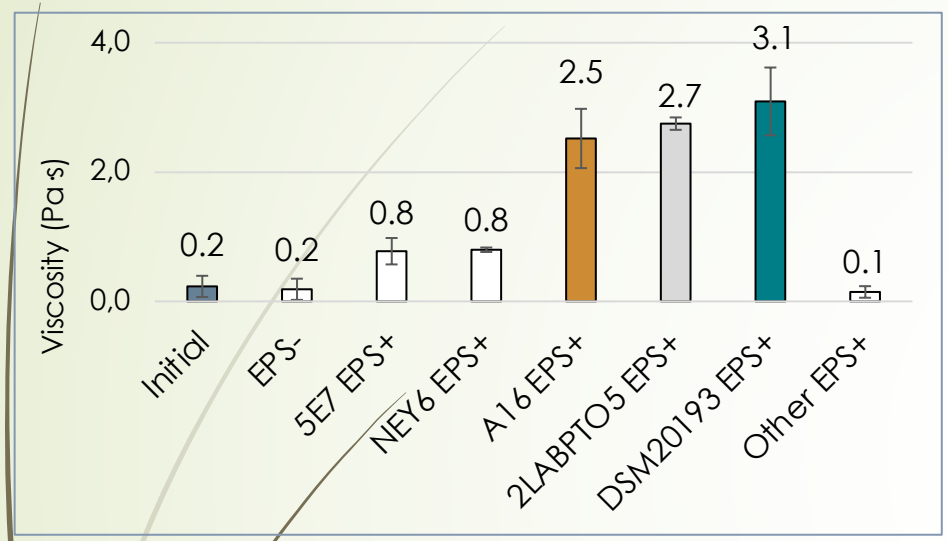


Department of Environmental Biology, Sapienza University of Rome, Italy

BSG bioprocessing: dextran synthesis by Lactic Acid Bacteria

UNIVERSITY OF HELSINKI

Viscosity increase



Untreated spent

Fermented spent

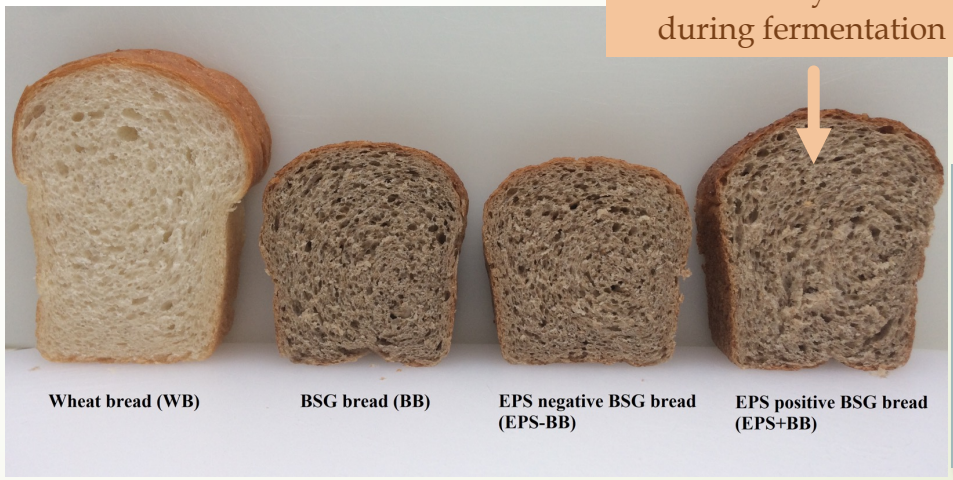
- BSG amount: ca. 33-37% of dough weigh
- Dextran content ca. 1.6% w/w→ 0.59% of dextran in bread (effective as hydrocolloid)

RESEARCH Open Access

Brewers' spent grain as substrate for dextran biosynthesis by *Leuconostoc pseudomesenteroides* DSM20193 and *Weissella confusa* A16

Prabin Koirala[1], Ndegwa Henry Maina[1], Hanna Nihtilä[1], Kati Katina[1] and Rossana Coda[1,2*]

Dextran synthesis during fermentation



BSG bread containing dextran vs native BSG

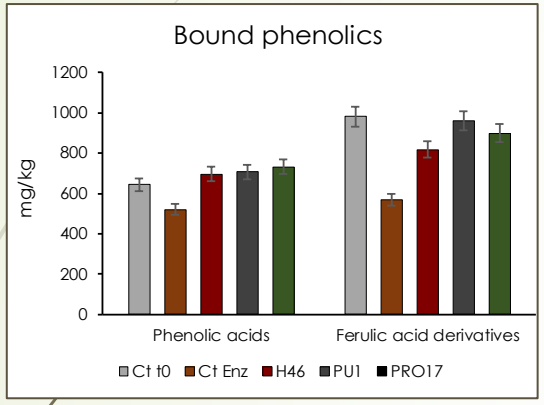
- Volume + 13%
- Hardness – 40%
- Staling rate – 33%
- taste/mouthfeel perception

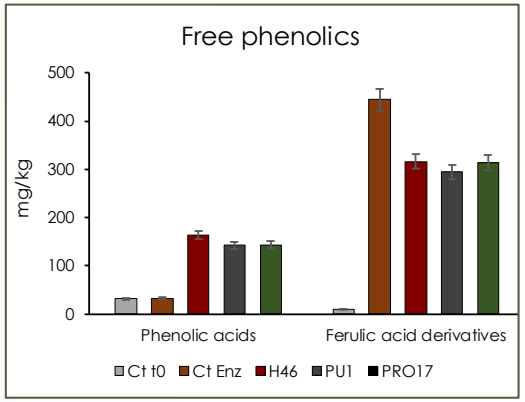
Department of Environmental Biology, Sapienza University of Rome, Italy

BSG bioprocessing: increase of the antioxidant activity

use of xylanase + lactic acid bacteria fermentation

Phenolic compounds

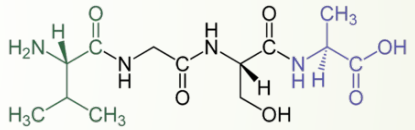


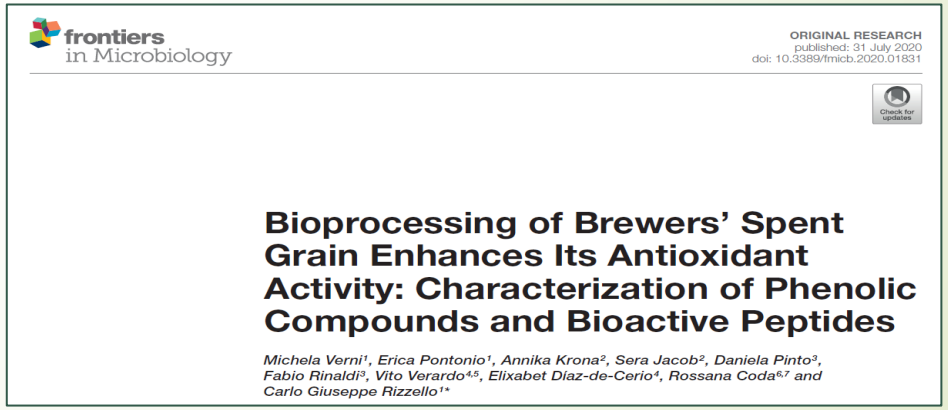


Xylanase liberated 25% of the **phenolic compounds bound to lignocellulosic** material and, therefore, not available to exert their function. Whereas **LAB metabolized phenolic acids** and polymeric forms of **proanthocyanidins** into more active forms.

Bioactive peptides

LAB proteolytic system enabled the **release of small bioactive peptides** sequences encrypted in barley and maize native proteins, showing common features of antioxidant peptides.




frontiers in Microbiology

ORIGINAL RESEARCH
published: 31 July 2020
doi: 10.3389/fmicb.2020.01831

Bioprocessing of Brewers' Spent Grain Enhances Its Antioxidant Activity: Characterization of Phenolic Compounds and Bioactive Peptides

Michela Verni[1], Erica Pontonio[1], Annika Krona[2], Sera Jacob[2], Daniela Pinto[3], Fabio Rinaldi[3], Vito Verardo[4,5], Elixabet Díaz-de-Cerio[4], Rossana Coda[6,7] and Carlo Giuseppe Rizzello[1]

Department of Environmental Biology, Sapienza University of Rome, Italy

Bioprocessed BSG for functional pasta and extruded snacks

"High fiber" content (~8%)
"Source of protein"
according to EU regulation 1924/2006

Improved **Protein Digestibility** and quality indices

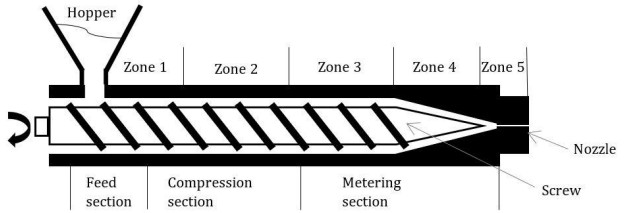
Low glycaemic index
compared to semolina pasta

antioxidants MDPI

Article

Bioprocessed Brewers' Spent Grain Improves Nutritional and Antioxidant Properties of Pasta

Rosa Schettino [1], Michela Verni [1], Marta Acin-Albiac [2], Olimpia Vincentini [3], Annika Krona [4], Antti Knaapila [5], Raffaella Di Cagno [2], Marco Gobbetti [2], Carlo Giuseppe Rizzello [6,*] and Rossana Coda [5,7]



expansion

- Blend ingredients; total water 26%
- Extrusion at 30/80/90/110/95 °C, 50 rpm
- Microwave 12 g at 750 W for 45 s to expand

Technological properties

- ✓ **Degraded arabinoxylan structure**
- ✓ More homogeneous **protein network**

Functional properties

- ✓ Rich in **phenolic compounds** and **bioactive peptides**
- ✓ Protective effects of **digested pasta** towards induced **oxidative stress** in Caco-2 cells cultures

RI. SE

Department of Environmental Biology, Sapienza University of Rome, Italy

Wasted Bread

- **European project WASTEBAKE**
- Biotechnological functionalization of bakery waste - *(Call: EUROTRANSBIO)*

- Valle Fiorita Catering Srl (Italy) - Koivulan Leipomo Oy (Finland) - Senson (Finland) - Iceberg LLC (Russia) – University of Bari (Italy) - University of Helsinki (Finland) - ITMO University (Russia)

Wasted Bread

Enrichment in EPS

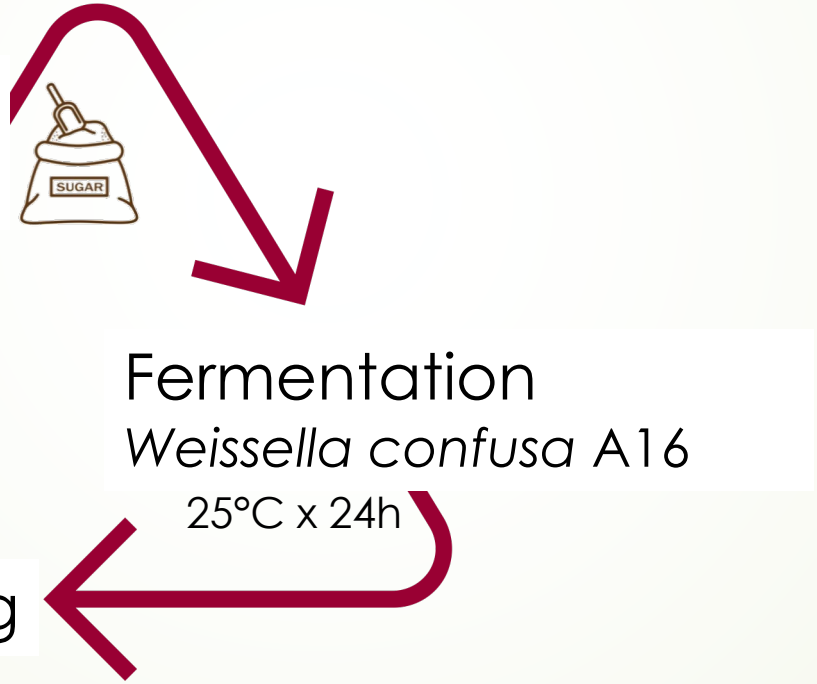
Contents lists available at ScienceDirect

International Journal of Food Microbiology

journal homepage: www.elsevier.com/locate/ijfoodmicro

Waste bread recycling as a baking ingredient by tailored lactic acid fermentation

Mikko Immonen[a,*], Ndegwa H. Maina[a], Yaqin Wang[a], Rossana Coda[a,b], Kati Katina[a]

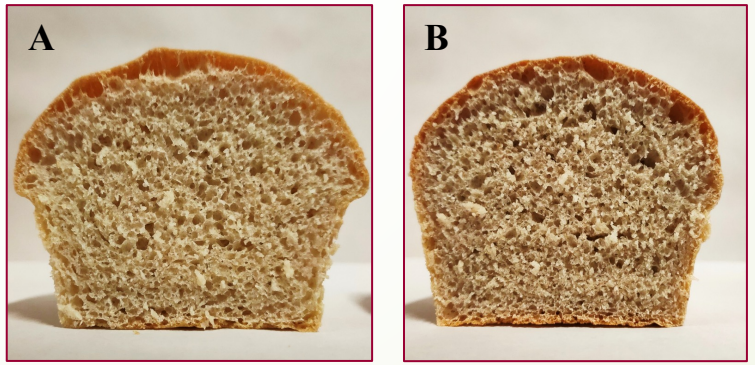


Wasted Bread

GABA enrichment

- **GABA content 136 mg/kg**
- **Higher Free Amino Acids**
- **Higher *In vitro* Protein Digetibility**
- **Lower predicted Glycaemic Index**
- **Good technological properties**

Image and cross section of common wheat flour bread (A) and **bread produced with surplus bread slurry containing 30% of wheat bran and fermented with *L. plantarum* H64** (B)



Alternative options for cereal by-products valorisation:

Substrate for the cultivation of starters


frontiers in Microbiology

ORIGINAL RESEARCH
published: 28 February 2020
doi: 10.3389/fmicb.2020.00293

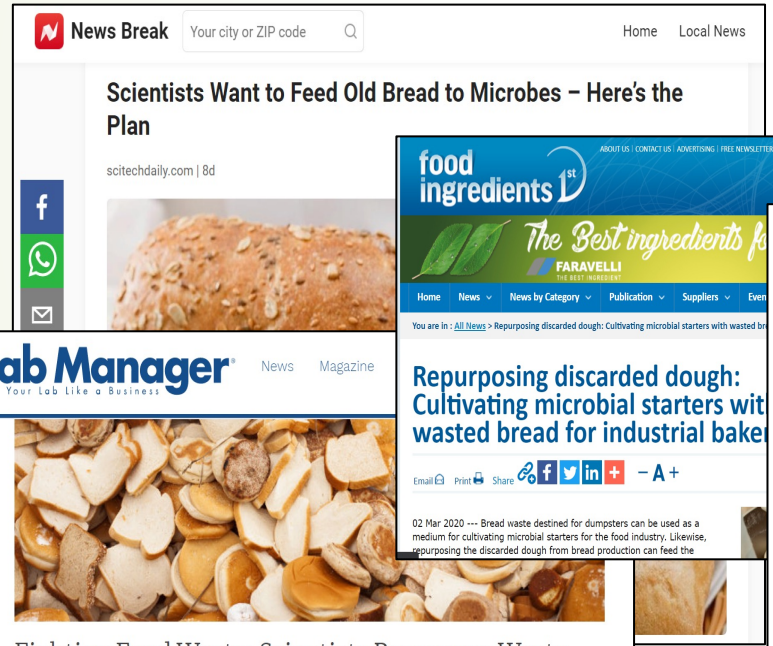
Wasted Bread as Substrate for the Cultivation of Starters for the Food Industry

Michela Verni[1], Andrea Minisci[2], Sonia Convertino[2], Luana Nionelli[2] and Carlo G. Rizzello[1]

vallefiorita®

Patent n. 102019000017408, 27.09.2019.

WBM
Wasted Bead Medium


News Break | Your city or ZIP code | Home | Local News

Scientists Want to Feed Old Bread to Microbes – Here's the Plan

scitechdaily.com | 8d

food ingredients 1st | nutrition insight | Packaging INSIGHTS

The Best ingredients f

FARAVELLI

Home | News | News by Category | Publication | Suppliers

Repurposing discarded dough: Cultivating microbial starters wit wasted bread for industrial bake

02 Mar 2020 --- Bread waste destined for dumpsters can be used as a medium for cultivating microbial starters for the food industry. Likewise, repurposing the discarded dough from bread production can feed the

Lab Manager
Run Your Lab Like a Business

News | Magazine

Fighting Food Waste: Scientists Repurpose Waste Bread to Feed Microbes

Researchers have developed a secret sauce for using waste bread as a medium to grow bacteria, yeasts, and other microorganisms for fermented food production

February 28th, 2020
FRONTIERS


FEBRUARY 28, 2020

Taking a bite out of food waste: Scientists repurpose waste bread to feed microbes

by Frontiers

Credit: CC0 Public Domain

Old bread is being given a new lease of life as scientists create a 'secret sauce' that allows it to be turned into yoghurt, wine and even new bread - all in a bid waste

discarded bread into a platform for yeast to grow in
ve to the unused loaves being sent to landfill sites
it could then be used in commercial bakeries
d by bakeries to recycle their own unused produce


Bread 'trash' is microbial treasure

Saturday, 29 February, 2020

Tonnes of bread end up in landfill every year, but researchers have now found a way to repurpose this discarded bread and dough. Research published in *Frontiers in Microbiology* has revealed that old bread can be used as a medium for cultivating microbial fermentation starters, which could have applications in food industries like bakeries, dairy and winemaking.

Next-generation soil-improvers

a FORK TO FARM approach?

- *Supplement for OC and TN*
- *LAB as PGPM*
- *Acidification effect*
- *Antimicrobial activity*

Chemical and physicochemical properties of CTR, WBA and FWBA soils

Samples	pH_{H2O}	pH_{KCl}	EC $\mu S\ m^{-1}$	O.C. %	TN %	P_{ava} $mg\ kg^{-1}$
T0	8.2 a	7.2	200 b	16.0 b	1.6 bc	45.5 ab
CTR	8.2 a	7.3	319 b	15.2 b	1.5 c	46.9 a
WBA	7.7 b	7.3	805 a	20.3 a	2.1 a	37.3 bc
bWBA	7.7 b	7.2	764 a	20.8 a	1.9 ab	36.1 c
HSD.test	***	ns	***	***	**	**

Mean biometric features of plants at the end of the trial

Samples	Average n. of leaves/plant	Treated/CTP leaves ratio	Average head escarole fresh weight (g)	Treated/CTP yield ratio
CTP	13 b	-	18.2 b	-
WBP	22 a	1.7	64.5 a	1.97
bWBP	19 ab	1.4	55.9 a	1.70
HSD.test	*	ns	***	ns

foods

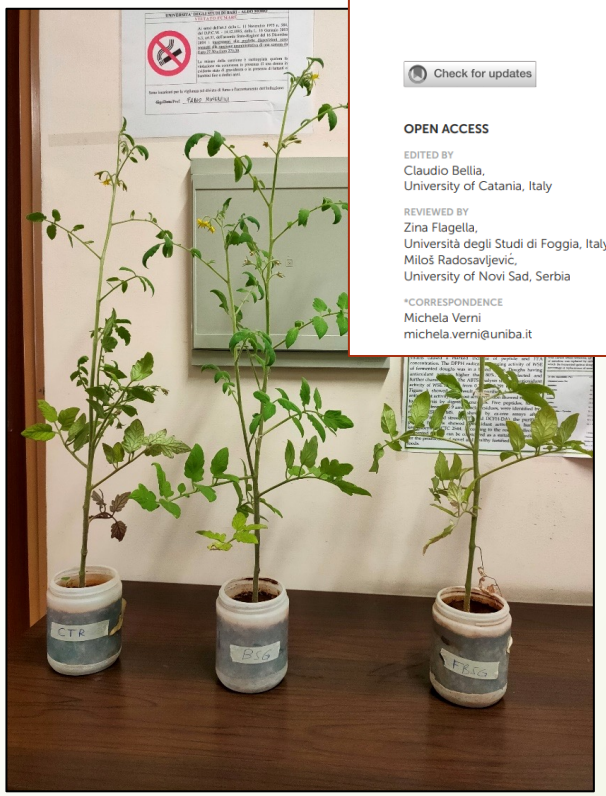
MDPI

Article

Reuse of Wasted Bread as Soil Amendment: Bioprocessing, Effects on Alkaline Soil and Escarole (*Cichorium endivia*) Production

Claudio Cacace [1], Carlo Giuseppe Rizzello [2], Gennaro Brunetti [1], Michela Verni [1,*] and Claudio Cocozza [1]

8 weeks



frontiers | Frontiers in Sustainable Food Systems

TYPE Original Research
PUBLISHED 24 November 2022
DOI 10.3389/fsufs.2022.1010890

Check for updates

OPEN ACCESS

EDITED BY
Claudio Bellia,
University of Catania, Italy

REVIEWED BY
Zina Flagella,
Università degli Studi di Foggia, Italy
Miloš Radosavljević,
University of Novi Sad, Serbia

*CORRESPONDENCE
Michela Verni
michela.verni@uniba.it

Potential of native and bioprocessed brewers' spent grains as organic soil amendments

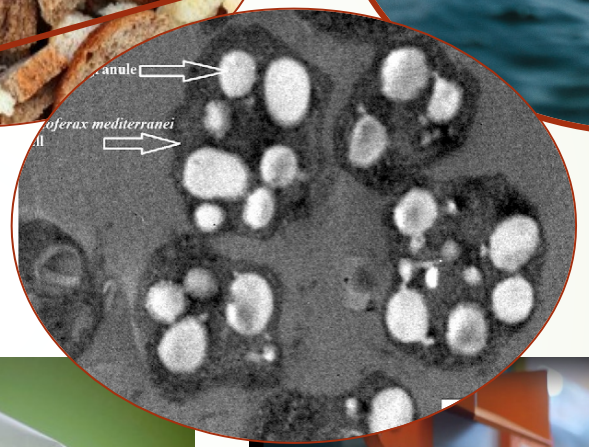
Claudio Cacace[1†], Claudio Cocozza[1†], Andreina Traversa[1], Rossana Coda[2,3], Carlo Giuseppe Rizzello[4], Erica Pontonio[1], Francesco De Mastro[1], Gennaro Brunetti[1] and Michela Verni[1*]

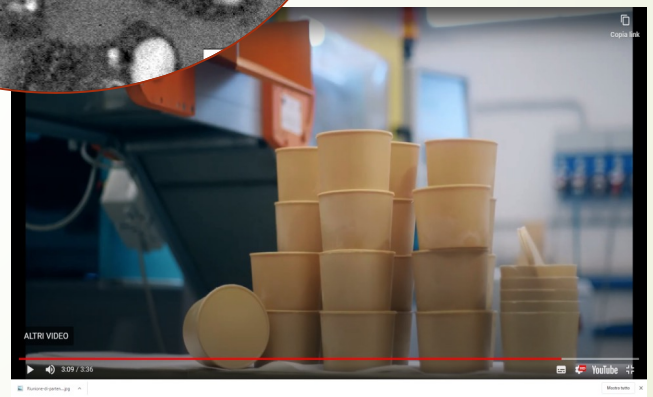
Department of Environmental Biology, Sapienza University of Rome, Italy

Bioplastic production (microbial synthesys of PHBV)

- ***Why Hfx mediterranei?***
  - *PHA-producer*
  - *Halophilic*
    - *No sterilization*
    - *Green Extraction*
  - *Starch metabolism*
  - ***Salts supplementation***

- ***Purity***
- ***Composition***
- ***Technological properties***





frontiers | Frontiers in Microbiology

TYPE Original Research
PUBLISHED 21 September 2022
DOI 10.3389/fmicb.2022.1000962

Check for updates

OPEN ACCESS

EDITED BY
Yinglong Su,
East China Normal University, China

REVIEWED BY
Steven Pratt,
The University of Queensland, Australia
Manish Kumar,
National Environmental Engineering Research Institute (CSIR), India
Sanjay Kumar Singh Patel,
Konkuk University, South Korea

*CORRESPONDENCE
Carlo Giuseppe Rizzello
carlogiuseppe.rizzello@uniroma1.it

SPECIALTY SECTION
This article was submitted to

Exploitation of wasted bread as substrate for polyhydroxyalkanoates production through the use of *Haloferax mediterranei* and seawater

Marco Montemurro[1], Gaia Salvatori[2], Sara Alfano[2], Andrea Martinelli[2], Michela Verni[1], Erica Pontonio[1], Marianna Villano[2,3] and Carlo Giuseppe Rizzello[4]*

Department of Environmental Biology, Sapienza University of Rome, Italy

Sapienza University of Rome, Italy
carlogiuseppe.rizzello@uniroma1.it

University of Bari Aldo Moro

Erica Pontonio
Michela Verni
Marco Montemurro
Giuseppe Perri
Chiara De Marinis
Andrea Torreggiani
Angela Longo

University of Helsinki
Rossana Coda
Kati Katina

Free University of Bozen
Marco Gobbetti
Raffaella di Cagno