

Supplementary materials: Tables

Table S1. Environmental impact comparison of mayonnaise and enriched mayonnaise considering commercial unit, potential shelf-life and TPC parameters.

Impact category	Unit	Commercial unit		Potential shelf-life		TPC	
		Mayo control	Mayo + OMWW PE	Mayo control	Mayo + OMWW PE	Mayo control	Mayo + OMWW PE
GW ¹	kg CO ₂ eq	6.75 x10⁻¹	1.26	1.35	1.26	2.79 x10 ⁻²	1.26
OD ²	kg CFC11 eq	6.05 x10⁻⁶	6.44 x10 ⁻⁶	1.21 x10 ⁻⁵	6.44 x10⁻⁶	2.50 x10 ⁻³	6.44 x10⁻⁶
IR ³	kBq ⁶⁰ Co eq	2.20 x10⁻²	8.16 x10 ⁻²	4.40 x10⁻²	8.16 x10 ⁻²	9.09	8.16 x10⁻²
OF-HH ⁴	kg NO _x eq	2.27 x10⁻³	3.28 x10 ⁻³	4.53 x10 ⁻³	3.28 x10⁻³	9.36 x10 ⁻¹	3.28 x10⁻³
PM ⁵	kg PM _{2.5} eq	1.26 x10⁻³	1.90 x10 ⁻³	2.52 x10 ⁻³	1.90 x10⁻³	5.20 x10 ⁻¹	1.90 x10⁻³
OF-TE ⁶	kg NO _x eq	2.33 x10⁻³	3.38 x10 ⁻³	4.65 x10 ⁻³	3.38 x10⁻³	9.61 x10 ⁻¹	3.38 x10⁻³
TA ⁷	kg SO ₂ eq	5.09 x10⁻³	7.06 x10 ⁻³	1.02 x10 ⁻²	7.06 x10⁻³	2.10	7.06 x10⁻³
FE ⁸	kg P eq	2.16 x10⁻⁴	3.59 x10 ⁻⁴	4.33 x10 ⁻⁴	3.59 x10⁻⁴	8.94 x10 ⁻²	3.59 x10⁻⁴
ME ⁹	kg N eq	2.53 x10 ⁻³	2.51 x10⁻³	5.06 x10 ⁻³	2.51 x10⁻³	1.05	2.51 x10⁻³
TE ¹⁰	kg 1,4-DCB	2.32	2.95	4.64	2.95	9.57 x10 ⁺²	2.95
FRE ¹¹	kg 1,4-DCB	9.64 x10⁻²	1.11 x10 ⁻¹	1.93 x10 ⁻¹	1.11 x10⁻¹	3.98 x10 ⁺¹	1.11 x10⁻¹
MECO ¹²	kg 1,4-DCB	3.59 x10⁻²	5.46 x10 ⁻²	7.18 x10 ⁻²	5.46 x10⁻²	1.48 x10 ⁺¹	5.46 x10⁻²
HCT ¹³	kg 1,4-DCB	1.52 x10⁻²	2.72 x10 ⁻²	3.03 x10 ⁻²	2.72 x10⁻²	6.26	2.72 x10⁻²
HNCT ¹⁴	kg 1,4-DCB	1.43	1.72	2.86	1.72	5.90 x10 ⁺²	1.72
LU ¹⁵	m ² a crop eq	1.78	1.78	3.55	1.78	7.34 x10 ⁺²	1.78
MRS ¹⁶	kg Cu eq	7.49 x10⁻³	8.08 x10 ⁻³	1.50 x10 ⁻²	8.08 x10⁻³	3.09	8.08 x10⁻³
FRS ¹⁷	kg oil eq	1.39 x10⁻¹	3.25 x10 ⁻¹	2.78 x10⁻¹	3.25 x10 ⁻¹	5.74 x10 ⁺¹	3.25 x10⁻¹
WC ¹⁸	m ³	5.65 x10⁻³	1.37 x10 ⁻²	1.13 x10⁻²	1.37 x10 ⁻²	2.33	1.37 x10⁻²

¹Global warming. ²Stratospheric ozone depletion. ³Ionizing radiation. ⁴Ozone formation, human health. ⁵Fine particulate matter formation. ⁶Ozone formation, terrestrial ecosystems. ⁷Terrestrial acidification. ⁸Freshwater eutrophication. ⁹Marine eutrophication. ¹⁰Terrestrial ecotoxicity. ¹¹Freshwater ecotoxicity. ¹²Marine ecotoxicity. ¹³Human carcinogenic toxicity. ¹⁴Human non-carcinogenic toxicity. ¹⁵Land use. ¹⁶Mineral resource scarcity. ¹⁷Fossil resource scarcity. ¹⁸Water consumption.

Table S2. Environmental impact comparison of salad dressing and enriched salad dressing considering commercial unit and TPC parameters.

Impact category	Unit	Commercial unit		TPC	
		Salad dressing Control	Salad dressing + eOLE	Salad dressing Control	Salad dressing + eOLE
GW ¹	kg CO ₂ eq	1.01 x10⁻¹	5.66 x10 ⁻¹	1.63 x10 ⁺¹	5.66 x10⁻¹
OD ²	kg CFC11 eq	1.13 x10⁻⁶	2.05 x10 ⁻⁶	1.83 x10 ⁻⁴	2.05 x10⁻⁶
IR ³	kBq ⁶⁰ Co eq	4.66 x10⁻³	5.09 x10 ⁻²	7.56 x10 ⁻¹	5.09 x10⁻²
OF-HH ⁴	kg NO _x eq	2.84 x10⁻⁴	1.21 x10 ⁻³	4.60 x10 ⁻²	1.21 x10⁻³
PM ⁵	kg PM _{2.5} eq	1.36 x10⁻⁴	7.28 x10 ⁻⁴	2.20 x10 ⁻²	7.28 x10⁻⁴
OF-TE ⁶	kg NO _x eq	2.87 x10⁻⁴	1.23 x10 ⁻³	4.65 x10 ⁻²	1.23 x10⁻³
TA ⁷	kg SO ₂ eq	7.33 x10⁻⁴	2.67 x10 ⁻³	1.19 x10 ⁻¹	2.67 x10⁻³
FE ⁸	kg P eq	2.88 x10⁻⁵	1.53 x10 ⁻⁴	4.67 x10 ⁻³	1.53 x10⁻⁴
ME ⁹	kg N eq	3.49 x10⁻⁴	6.14 x10 ⁻⁴	5.65 x10 ⁻²	6.14 x10⁻⁴
TE ¹⁰	kg 1,4-DCB	3.20 x10⁻¹	9.70 x10 ⁻¹	5.18 x10 ⁺¹	9.70 x10⁻¹
FRE ¹¹	kg 1,4-DCB	9.45 x10⁻³	2.95 x10 ⁻²	1.53	2.95 x10⁻²
MECO ¹²	kg 1,4-DCB	2.39 x10⁻³	1.90 x10 ⁻²	3.87 x10 ⁻¹	1.90 x10⁻²
HCT ¹³	kg 1,4-DCB	3.87 x10⁻⁴	1.06 x10 ⁻²	6.28 x10 ⁻²	1.06 x10⁻²
HNCT ¹⁴	kg 1,4-DCB	1.58 x10⁻¹	5.08 x10 ⁻¹	2.55 x10 ⁺¹	5.08 x10⁻¹
LU ¹⁵	m ² a crop eq	2.02 x10⁻¹	4.10 x10 ⁻¹	3.27 x10 ⁺¹	4.10 x10⁻¹
MRS ¹⁶	kg Cu eq	1.09 x10⁻⁴	1.30 x10 ⁻³	1.77 x10 ⁻²	1.30 x10⁻³
FRS ¹⁷	kg oil eq	2.11 x10⁻²	1.55 x10 ⁻¹	3.42	1.55 x10⁻¹
WC ¹⁸	m ³	1.40 x10⁻²	2.04 x10 ⁻²	2.26	2.04 x10⁻²

¹Global warming. ²Stratospheric ozone depletion. ³Ionizing radiation. ⁴Ozone formation, human health. ⁵Fine particulate matter formation. ⁶Ozone formation, terrestrial ecosystems. ⁷Terrestrial acidification. ⁸Freshwater eutrophication. ⁹Marine eutrophication. ¹⁰Terrestrial ecotoxicity. ¹¹Freshwater ecotoxicity. ¹²Marine ecotoxicity. ¹³Human carcinogenic toxicity. ¹⁴Human non-carcinogenic toxicity. ¹⁵Land use. ¹⁶Mineral resource scarcity. ¹⁷Fossil resource scarcity. ¹⁸Water consumption.

Table S3. Environmental impact comparison of biscuits and enriched biscuits considering commercial unit, technological and nutritional parameters.

Impact category	Unit	Commercial unit		Potential shelf life		TPC	
		Biscuits Control	Biscuits + eOLE	Biscuits Control	Biscuits + eOLE	Biscuits Control	Biscuits + eOLE
GW ¹	kg CO ₂ eq	6.76 x10⁻¹	1.53	9.17 x10⁻¹	1.53	9.83 x10⁻¹	1.53
OD ²	kg CFC11 eq	3.14 x10⁻⁶	4.91 x10 ⁻⁶	4.26 x10⁻⁶	4.91 x10 ⁻⁶	4.57 x10⁻⁶	4.91 x10 ⁻⁶
IR ³	kBq ⁶⁰ Co eq	2.10 x10⁻²	1.05 x10 ⁻¹	2.84 x10⁻²	1.05 x10 ⁻¹	3.05 x10⁻²	1.05 x10 ⁻¹
OF-HH ⁴	kg NO _x eq	2.36 x10⁻³	4.06 x10 ⁻³	3.20 x10⁻³	4.06 x10 ⁻³	3.43 x10⁻³	4.06 x10 ⁻³
PM ⁵	kg PM _{2.5} eq	8.99 x10⁻⁴	1.98 x10 ⁻³	1.22 x10⁻³	1.98 x10 ⁻³	1.31 x10⁻³	1.98 x10 ⁻³
OF-TE ⁶	kg NO _x eq	2.38 x10⁻³	4.12 x10 ⁻³	3.22 x10⁻³	4.12 x10 ⁻³	3.46 x10⁻³	4.12 x10 ⁻³
TA ⁷	kg SO ₂ eq	4.06 x10⁻³	7.63 x10 ⁻³	5.50 x10⁻³	7.63 x10 ⁻³	5.90 x10⁻³	7.63 x10 ⁻³
FE ⁸	kg P eq	1.06 x10⁻⁴	3.32 x10 ⁻⁴	1.44 x10⁻⁴	3.32 x10 ⁻⁴	1.54 x10⁻⁴	3.32 x10 ⁻⁴
ME ⁹	kg N eq	7.45 x10⁻⁴	1.26 x10 ⁻³	1.01 x10⁻³	1.26 x10 ⁻³	1.08 x10⁻³	1.26 x10 ⁻³
TE ¹⁰	kg 1,4-DCB	1.01	2.22	1.37	2.22	1.47	2.22
FRE ¹¹	kg 1,4-DCB	1.34 x10⁻²	5.07 x10 ⁻²	1.82 x10⁻²	5.07 x10 ⁻²	1.96 x10⁻²	5.07 x10 ⁻²
MECO ¹²	kg 1,4-DCB	1.08 x10⁻²	4.11 x10 ⁻²	1.46 x10⁻²	4.11 x10 ⁻²	1.57 x10⁻²	4.11 x10 ⁻²
HCT ¹³	kg 1,4-DCB	7.60 x10⁻³	2.61 x10 ⁻²	1.03 x10⁻²	2.61 x10 ⁻²	1.11 x10⁻²	2.61 x10 ⁻²
HNCT ¹⁴	kg 1,4-DCB	4.66 x10⁻¹	1.12	6.32 x10⁻¹	1.12	6.78 x10⁻¹	1.12
LU ¹⁵	m ² a crop eq	7.25 x10⁻¹	1.12	9.83 x10⁻¹	1.12	1.05	1.12
MRS ¹⁶	kg Cu eq	3.10 x10⁻³	5.27 x10 ⁻³	4.21 x10⁻³	5.27 x10 ⁻³	4.51 x10⁻³	5.27 x10 ⁻³
FRS ¹⁷	kg oil eq	6.77 x10⁻²	3.12 x10 ⁻¹	9.17 x10⁻²	3.12 x10 ⁻¹	9.84 x10⁻²	3.12 x10 ⁻¹
WC ¹⁸	m ³	6.57 x10⁻³	1.95 x10 ⁻²	8.91 x10⁻³	1.95 x10 ⁻²	9.56 x10⁻³	1.95 x10 ⁻²

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Table S4. Environmental impact comparison of gluten free breadsticks and enriched GFB considering commercial unit, technological and nutritional parameters.

Impact category	Unit	Commercial unit			Potential shelf life			TPC		
		GFB control	GFB + OLE	GFB + OMWW PE	GFB control	GFB + OLE	GFB + OMWW PE	GFB control	GFB + OLE	GFB + OMWW PE
GW ¹	kg CO ₂ eq	2.77 x10⁻¹	3.82 x10 ⁻¹	2.80 x10 ⁻¹	4.99 x10 ⁻¹	5.15 x10 ⁻¹	2.80 x10⁻¹	3.19 x10 ⁻¹	3.82 x10 ⁻¹	3.00 x10⁻¹
OD ²	kg CFC11 eq	2.56 x10⁻⁶	2.64 x10 ⁻⁶	2.56 x10⁻⁶	4.60 x10 ⁻⁶	3.57 x10 ⁻⁶	2.56 x10⁻⁶	2.94 x10 ⁻⁶	2.64 x10⁻⁶	2.74 x10⁻⁶
IR ³	kBq ⁶⁰ Co eq	9.76 x10⁻³	2.15 x10 ⁻²	1.01 x10 ⁻²	1.76 x10 ⁻²	2.90 x10 ⁻²	1.01 x10⁻²	1.12 x10 ⁻²	2.15 x10 ⁻²	1.08 x10⁻²
OF-HH ⁴	kg NO _x eq	8.64 x10⁻⁴	1.05 x10 ⁻³	8.70 x10 ⁻⁴	1.56 x10 ⁻³	1.41 x10 ⁻³	8.70 x10⁻⁴	9.94 x10 ⁻⁴	1.05 x10 ⁻³	9.30 x10⁻⁴
PM ⁵	kg PM _{2.5} eq	4.76 x10⁻⁴	5.98 x10 ⁻⁴	4.80 x10 ⁻⁴	8.58 x10 ⁻⁴	8.07 x10 ⁻⁴	4.80 x10⁻⁴	5.48 x10 ⁻⁴	5.98 x10 ⁻⁴	5.13 x10⁻⁴
OF-TE ⁶	kg NO _x eq	8.78 x10⁻⁴	1.06 x10 ⁻³	8.83 x10 ⁻⁴	1.58 x10 ⁻³	1.44 x10 ⁻³	8.83 x10⁻⁴	1.01 x10 ⁻³	1.06 x10 ⁻³	9.45 x10⁻⁴
TA ⁷	kg SO ₂ eq	2.24 x10⁻³	2.61 x10 ⁻³	2.25 x10 ⁻³	4.02 x10 ⁻³	3.52 x10 ⁻³	2.25 x10⁻³	2.57 x10 ⁻³	2.61 x10 ⁻³	2.40 x10⁻³
FE ⁸	kg P eq	8.64 x10⁻⁵	1.13 x10 ⁻⁴	8.71 x10 ⁻⁵	1.55 x10 ⁻⁴	1.52 x10 ⁻⁴	8.71 x10⁻⁵	9.93 x10 ⁻⁵	1.13 x10 ⁻⁴	9.32 x10⁻⁵
ME ⁹	kg N eq	8.93 x10⁻⁴	8.95 x10 ⁻⁴	8.93 x10⁻⁴	1.61 x10 ⁻³	1.21 x10 ⁻³	8.93 x10⁻⁴	1.03 x10 ⁻³	8.95 x10 ⁻⁴	9.56 x10⁻⁴
TE ¹⁰	kg 1,4-DCB	8.93 x10⁻¹	1.00	8.96 x10 ⁻¹	1.61	1.35	8.96 x10⁻¹	1.03	1.00	9.59 x10⁻¹
FRE ¹¹	kg 1,4-DCB	2.90 x10⁻²	3.16 x10 ⁻²	2.91 x10 ⁻²	5.22 x10 ⁻²	4.27 x10 ⁻²	2.91 x10⁻²	3.34 x10 ⁻²	3.16 x10 ⁻²	3.11 x10⁻²
MECO ¹²	kg 1,4-DCB	1.20 x10⁻²	1.53 x10 ⁻²	1.21 x10 ⁻²	2.15 x10 ⁻²	2.07 x10 ⁻²	1.21 x10⁻²	1.38 x10 ⁻²	1.53 x10 ⁻²	1.29 x10⁻²
HCT ¹³	kg 1,4-DCB	3.58 x10⁻³	5.84 x10 ⁻³	3.64 x10 ⁻³	6.45 x10 ⁻³	7.89 x10 ⁻³	3.64 x10⁻³	4.12 x10 ⁻³	5.84 x10 ⁻³	3.90 x10⁻³
HNCT ¹⁴	kg 1,4-DCB	4.74 x10⁻¹	5.27 x10 ⁻¹	4.75 x10 ⁻¹	8.53 x10 ⁻¹	7.11 x10 ⁻¹	4.75 x10⁻¹	5.45 x10 ⁻¹	5.27 x10 ⁻¹	5.08 x10⁻¹
LU ¹⁵	m ² a crop eq	6.81 x10⁻¹	6.85 x10 ⁻¹	6.81 x10⁻¹	1.23	9.24 x10 ⁻¹	6.81 x10⁻¹	7.83 x10 ⁻¹	6.85 x10 ⁻¹	7.28 x10⁻¹
MRS ¹⁶	kg Cu eq	1.22 x10⁻³	1.31 x10 ⁻³	1.22 x10⁻³	2.19 x10 ⁻³	1.77 x10 ⁻³	1.22 x10⁻³	1.40 x10 ⁻³	1.31 x10⁻³	1.31 x10⁻³
FRS ¹⁷	kg oil eq	5.31 x10⁻²	8.40 x10 ⁻²	5.40 x10 ⁻²	9.55 x10 ⁻²	1.13 x10 ⁻¹	5.40 x10⁻²	6.10 x10 ⁻²	8.40 x10 ⁻²	5.78 x10⁻²
WC ¹⁸	m ³	2.55 x10⁻²	2.73 x10 ⁻²	2.56 x10 ⁻²	4.59 x10 ⁻²	3.68 x10 ⁻²	2.56 x10⁻²	2.94 x10 ⁻²	2.73 x10⁻²	2.74 x10 ⁻²

¹Global warming. ²Stratospheric ozone depletion. ³Ionizing radiation. ⁴Ozone formation, human health. ⁵Fine particulate matter formation. ⁶Ozone formation, terrestrial ecosystems. ⁷Terrestrial acidification. ⁸Freshwater eutrophication. ⁹Marine eutrophication. ¹⁰Terrestrial ecotoxicity. ¹¹Freshwater ecotoxicity. ¹²Marine ecotoxicity. ¹³Human carcinogenic toxicity. ¹⁴Human non-carcinogenic toxicity. ¹⁵Land use. ¹⁶Mineral resource scarcity. ¹⁷Fossil resource scarcity. ¹⁸Water consumption.