

NUTRITIONAL SAFETY AND CHARACTERIZATION OF RICE IN GUINEA-BISSAU

**the impact of varieties, processing, and local
preferences for food security**

AIM OF THE STUDY

- Characterize rice varieties from Guinea-Bissau
- Identify whether there are nutritionally superior varieties
- Check whether the species and/or growing region impact nutritional characteristics
- Assess the impact of polishing

PARAMETERS STUDIED

Water Activity (preservation parameter)

Nutritional Composition

- Protein
- Fat
- Starch
- Fiber

- Vitamins (Vit-B1, Vit-B2, Vit-B3, Vit-B9, Vit-E)
- Minerals (K, Ca, Mg, P, S, Fe, Cu, Zn, Mn)
- Amino acids profile (Histidine, Serine, Arginine, Glycine, Aspartic acid, Glutamic acid, Threonine, Alanine, Proline, Cysteine, Lysine, Tyrosine, Methionine, Valine, Isoleucine, Leucine, Phenylalanine)

Antioxidant activity

- FRAP, DPP, TPC

Heavy metals (contaminants)

- Pb, Cr, Ni, Cd

Nutritional characterisation of rice from Guinea-Bissau

Samples were in good condition for analysis

Water activity for all samples < 0.57

Very dry rice

With good preservation capacity

Only requiring insect control.

Heavy metals below the acceptable limit in all samples

Pb: 0 – 0.2 mg/100g

Cr: 0.1 – 0.5 mg/100g

Ni: 0.0 – 0.4 mg/100g

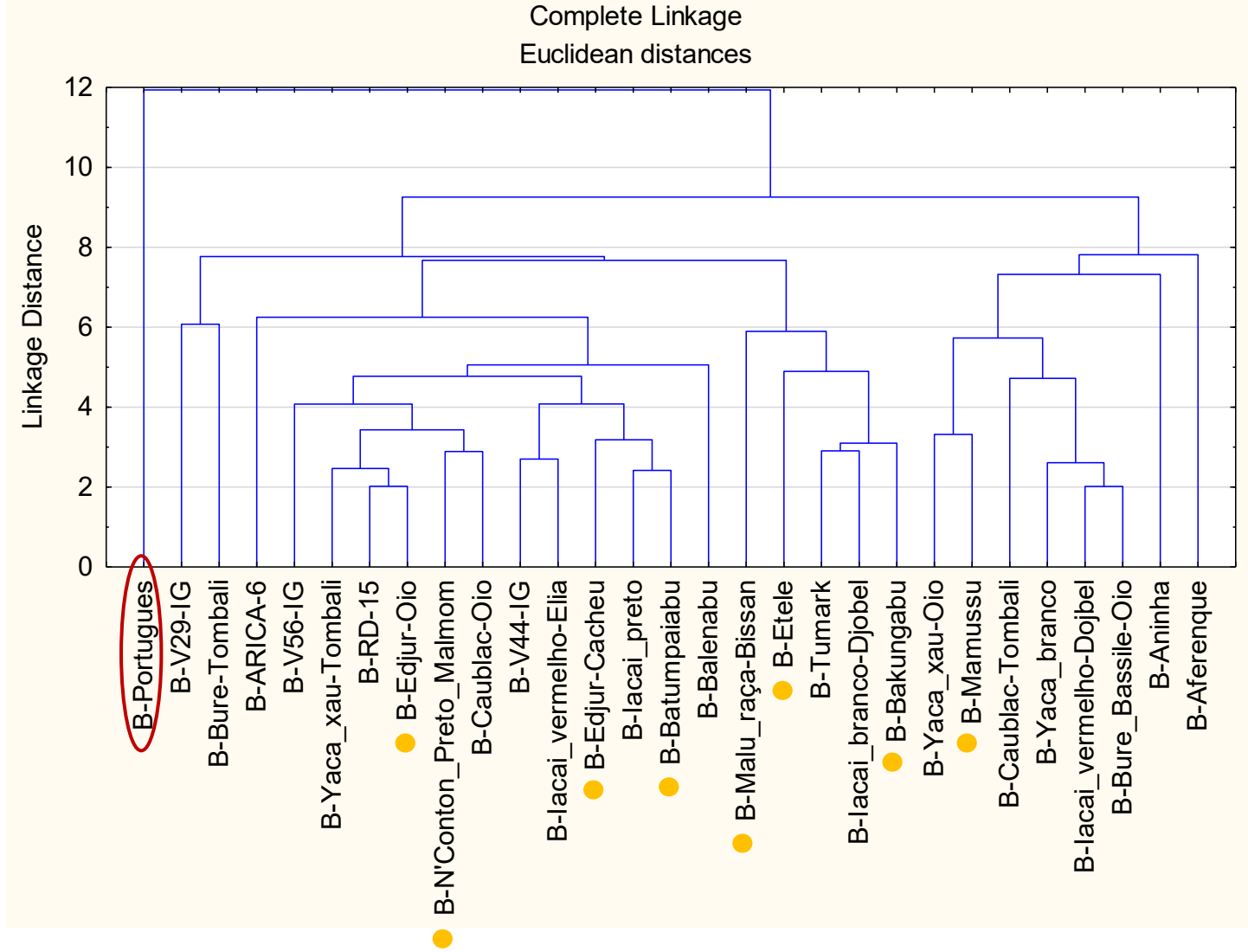
Cd: n.d.

Nutritional composition – Brown rice from Guinea-Bissau

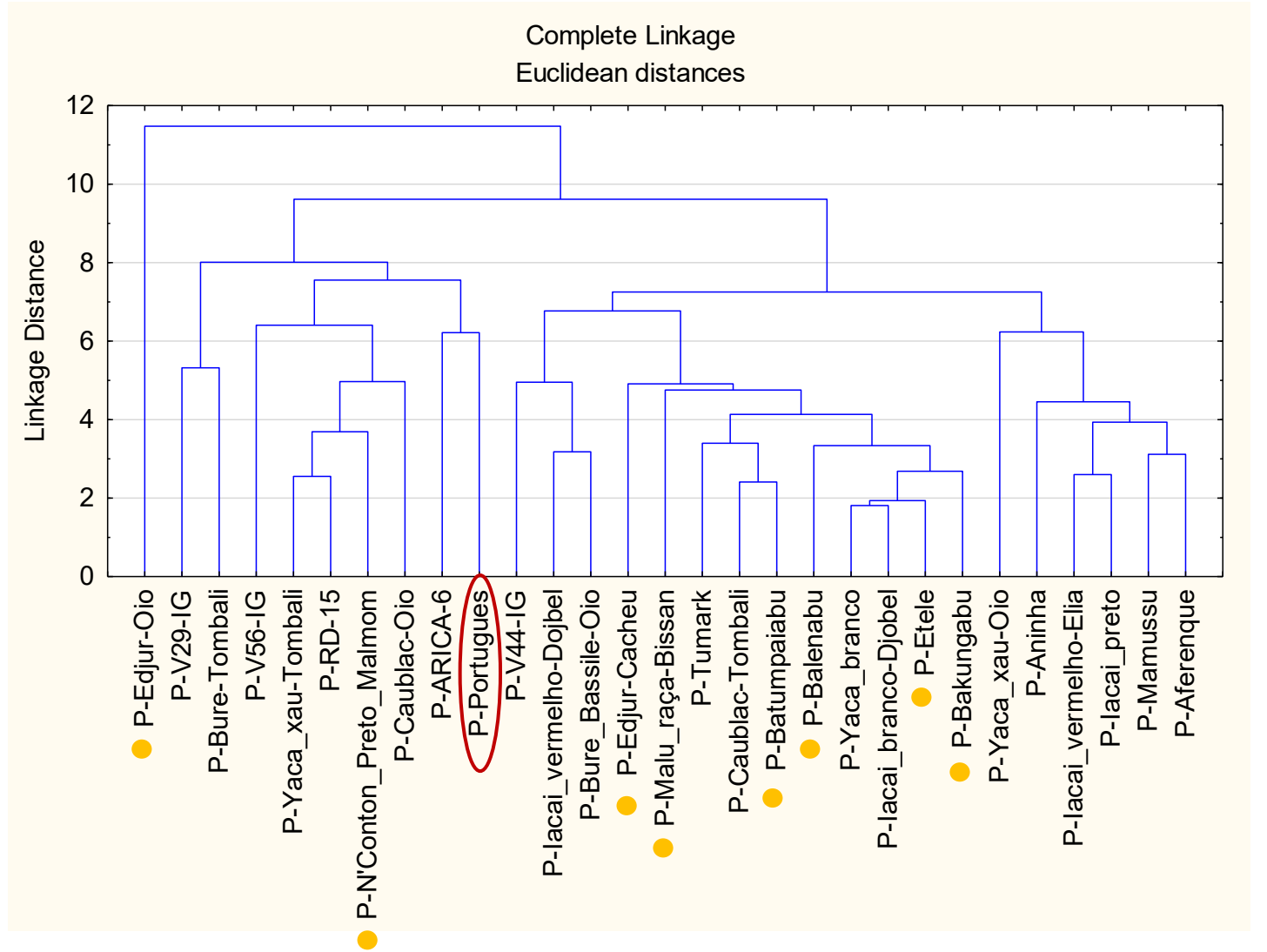
Sample	Protein	Fat	Fibre	Starch	Vitamin-B1	Vitamin-B2	Vitamin-B3	Vitamin-E	K	Ca	Mg	P	S	Fe	Cu	Zn	Mn
B-Aferenque	9.4	3.2	11.0	57.4	0.262	0.027	0.530	0.310	246.52	7.54	131.55	333.89	119.78	2.38	0.54	9.79	0.95
B-Aninha	8.4	0.5	7.2	61.9	0.369	0.034	0.000	0.390	304.08	5.22	142.68	334.26	112.03	4.51	0.57	2.42	0.62
B-Caublac-Tombali	14.3	3.6	8.1	62.7	0.289	0.064	0.000	0.240	271.86	4.75	145.22	350.52	111.52	3.14	0.20	2.73	1.35
B-Mamussu	10.5	2.7	8.9	69.3	0.263	0.028	0.530	0.400	263.94	1.43	135.01	338.01	114.39	6.14	0.25	2.84	0.65
B-Bure-Tombali	6.3	2.8	7.0	57.1	0.163	0.043	7.500	0.710	238.92	10.38	132.21	329.63	99.85	4.59	0.19	2.46	3.28
B-RD-15	6.8	2.9	6.0	58.7	0.230	0.034	1.220	0.480	210.90	5.46	119.08	293.89	85.44	3.98	0.16	2.07	1.16
B-V29-IG	10.2	1.9	5.8	55.9	0.182	0.033	3.530	0.190	250.79	7.05	156.05	377.74	118.91	3.69	0.56	2.75	4.02
B-V56-IG	7.3	2.3	5.9	59.8	0.259	0.028	5.630	0.320	218.46	4.20	121.74	308.68	91.27	4.16	0.15	2.09	1.22
B-Yaca_xau-Tombali	6.4	2.9	5.2	55.2	0.172	0.034	0.510	0.510	230.15	6.52	135.06	330.76	96.07	1.64	0.20	2.17	1.89
B-N'Conton_Preto_Malmom	7.0	2.8	6.0	63.1	0.192	0.026	0.000	0.260	222.61	6.60	126.75	319.58	89.68	2.60	0.20	2.17	1.97
B-Iacai_branco-Djobel	8.9	3.5	4.6	59.0	0.183	0.054	0.530	0.260	201.27	4.01	114.28	262.00	87.13	1.32	0.27	2.34	2.02
B-Iacai_preto	9.7	3.5	5.4	61.5	0.195	0.037	0.286	0.320	241.37	1.93	138.26	348.33	115.30	3.00	0.37	2.64	1.55
B-Iacai_vermelho-Dojbel	10.2	3.4	3.5	58.3	0.350	0.054	0.000	0.300	241.82	7.20	136.30	322.16	97.03	5.76	0.45	2.29	1.44
B-Iacai_vermelho-Elia	8.2	3.3	5.5	62.3	0.174	0.043	0.264	0.260	212.60	9.31	128.26	320.21	108.79	16.43	0.08	2.42	1.47
B-Tumark	9.3	3.4	4.9	58.5	0.135	0.043	0.710	0.370	161.30	8.54	94.35	215.82	100.18	1.97	0.47	3.24	1.85
B-Bakungabu	8.2	2.6	5.2	54.6	0.233	0.035	0.000	0.270	174.97	6.81	106.15	226.49	94.76	1.56	0.26	2.79	1.06
B-Balenabu	9.1	2.5	5.7	49.7	0.242	0.045	0.275	0.190	206.87	3.95	130.56	298.26	123.57	16.01	0.14	3.11	0.72
B-Batumpaibu	9.0	3.2	6.5	63.6	0.164	0.040	0.260	0.330	207.79	6.21	140.99	319.04	104.76	1.76	0.45	2.80	0.78
B-Edjur-Cacheu	7.6	2.9	5.9	60.0	0.300	0.049	0.274	0.310	220.85	2.74	147.53	339.14	108.29	2.84	0.39	2.97	2.08
B-Etele	9.5	2.8	6.4	60.9	0.260	0.041	0.590	0.340	141.63	13.81	75.22	155.01	93.12	2.83	0.44	2.72	1.14
B-Bure_Bassile-Oio	11.2	3.5	4.6	61.5	0.310	0.060	0.000	0.250	238.93	9.20	126.76	315.97	89.46	2.69	0.54	2.24	0.66
B-V44-IG	9.5	2.9	7.4	65.0	0.164	0.041	0.297	0.330	232.51	3.10	142.14	333.97	103.48	16.57	0.05	2.38	1.50
B-Yaca_branco	9.3	3.4	5.3	63.3	0.260	0.069	0.000	0.360	230.39	5.96	131.04	320.46	106.06	2.90	0.40	2.52	1.48
B-Yaca_xau-Oio	9.4	3.2	6.3	64.7	0.252	0.033	0.510	0.700	244.11	2.31	129.62	311.42	116.22	2.12	0.17	3.12	1.08
B-Caublac-Oio	6.9	3.1	4.5	64.5	0.220	0.041	1.250	0.430	238.20	2.57	133.04	329.80	109.01	9.12	0.15	2.27	1.77
B-Malu_raça-Bissan	8.3	2.9	7.4	65.0	0.164	0.041	0.297	0.330	183.10	9.65	126.59	269.36	87.77	36.66	0.28	2.38	1.62
B-Edjur-Oio	7.1	3.0	7.2	58.8	0.230	0.034	1.100	0.610	217.58	9.13	131.47	308.33	104.99	6.15	0.16	2.61	1.25
B-ARICA-6	7.9	3.2	3.7	60.2	0.000	0.000	1.090	0.130	220.65	3.00	112.82	298.72	109.61	9.81	0.17	1.90	2.24
B-Portugues * (control)	8.3	3.3	4.9	69.5	0.154	0.042	0.295	0.120	288.31	14.34	397.69	141.03	16.20	3.02	0.29	1.67	2.79

Min Avg Max
 Yellow = lowest | Light Blue = average | Green = highest

- **General overview**
Brown samples



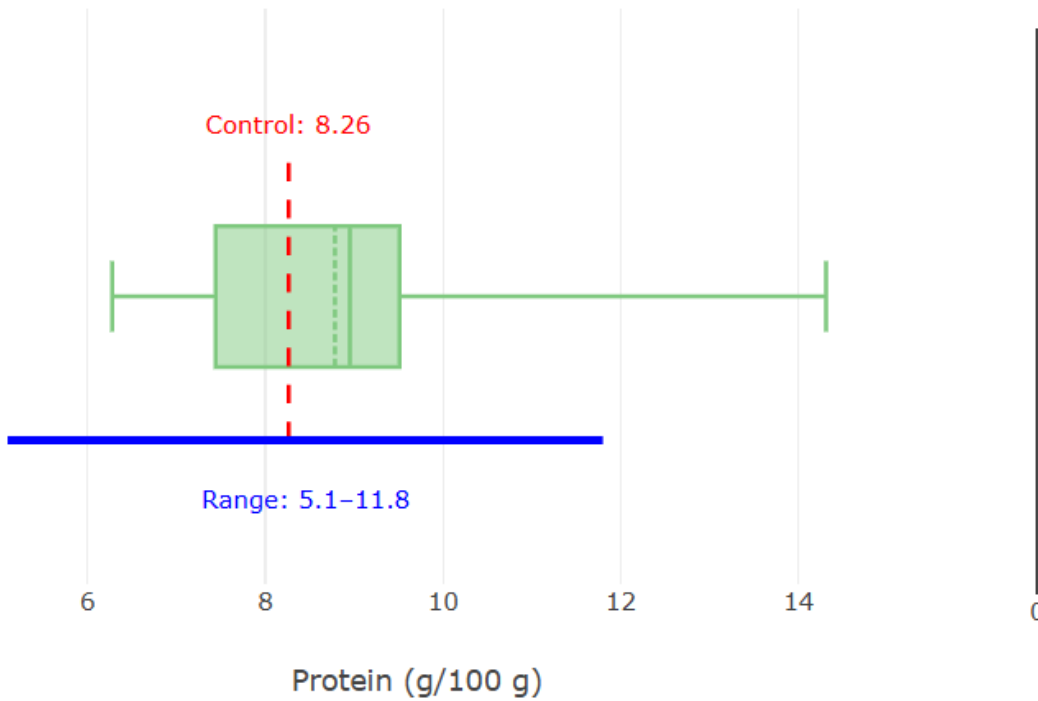
- General overview
Polished samples



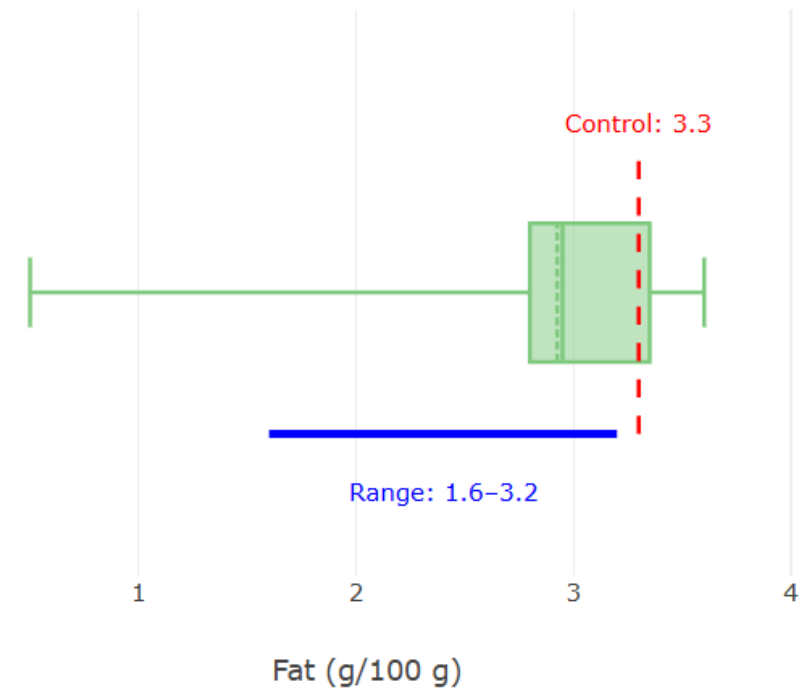
Nutritional composition – where does the Guinea-Bissau rice stands?

Macronutrients

Protein Content in Rice Varieties (g/100 g)



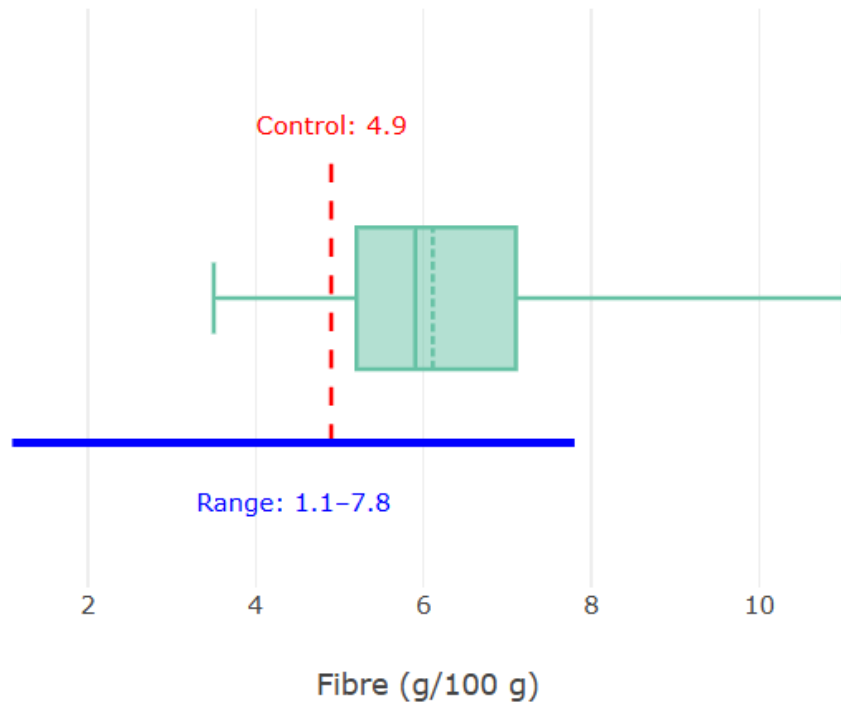
Fat Content in Rice Varieties (g/100 g)



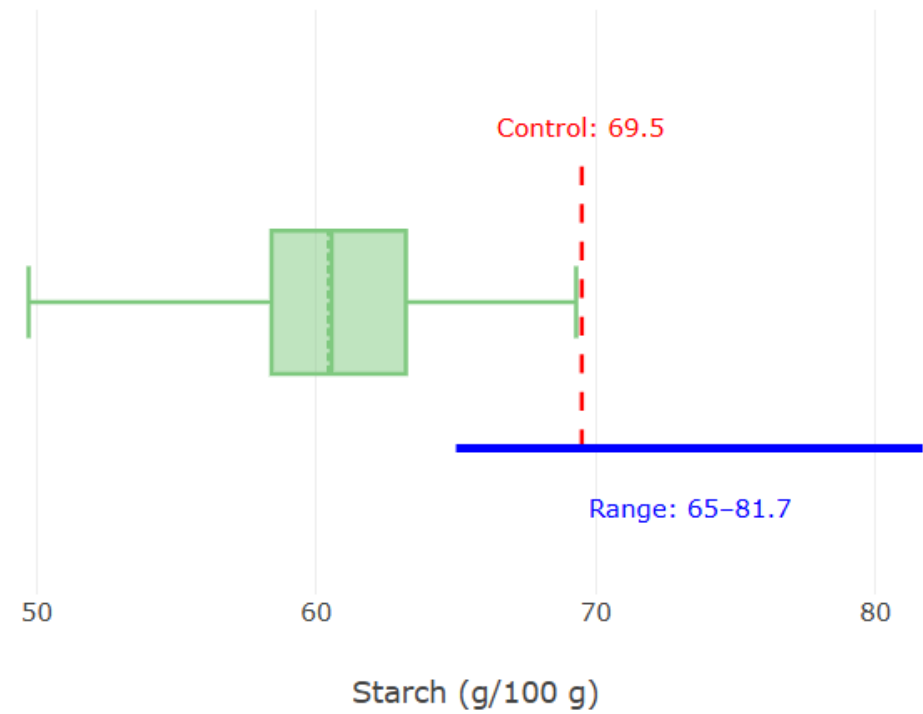
Nutritional composition – where does the Guinea-Bissau rice stands?

Macronutrients

Fibre Content in Rice Varieties (g/100 g)



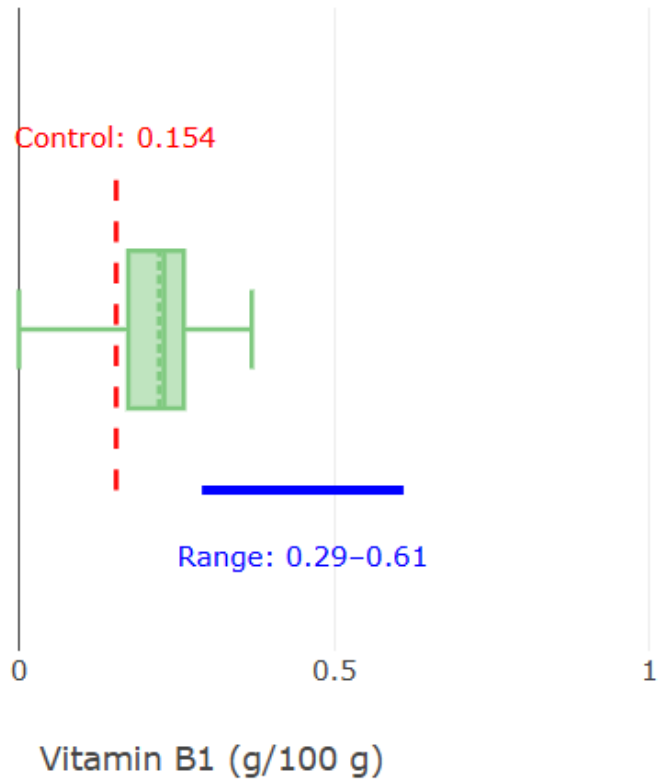
Starch Content in Rice Varieties (g/100 g)



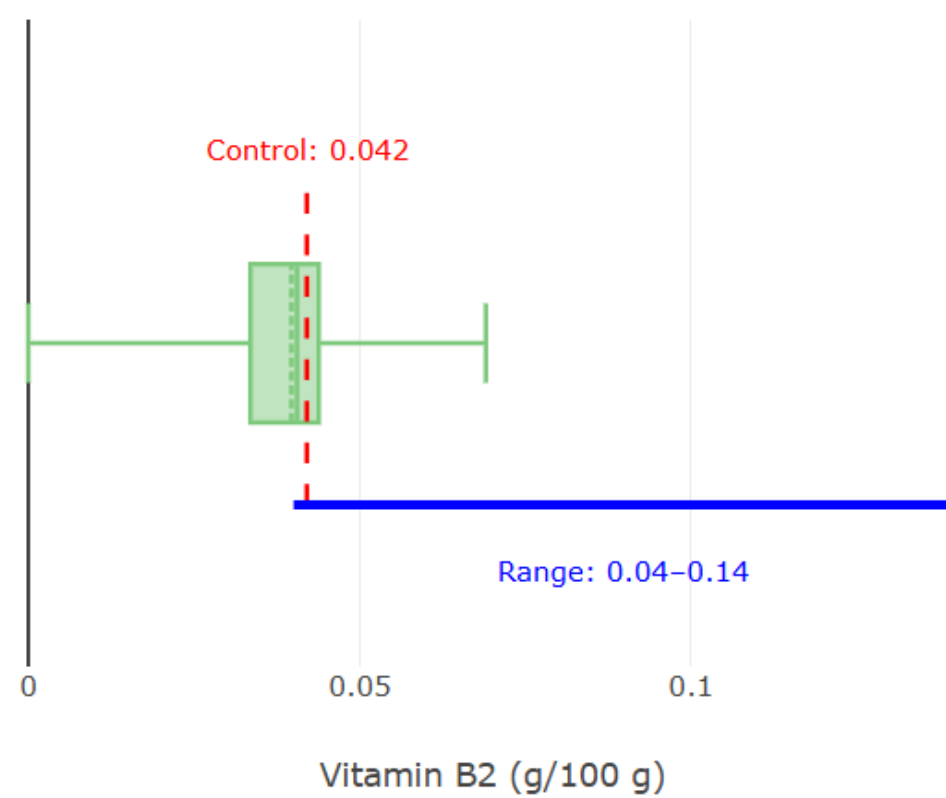
Nutritional composition – where does the Guinea-Bissau rice stands?

Vitamins

Vitamin B1 in Rice Varieties



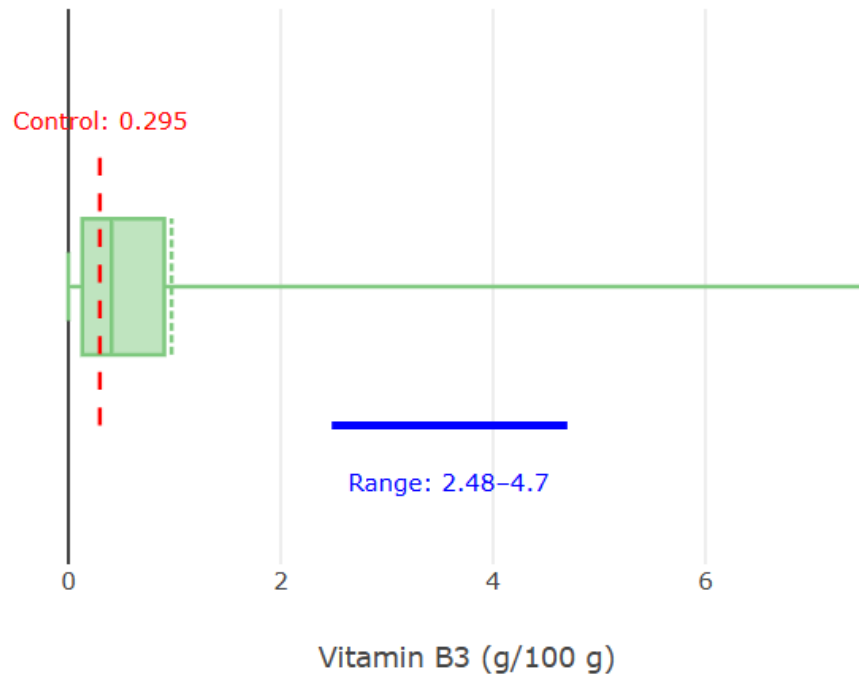
Vitamin B2 in Rice Varieties



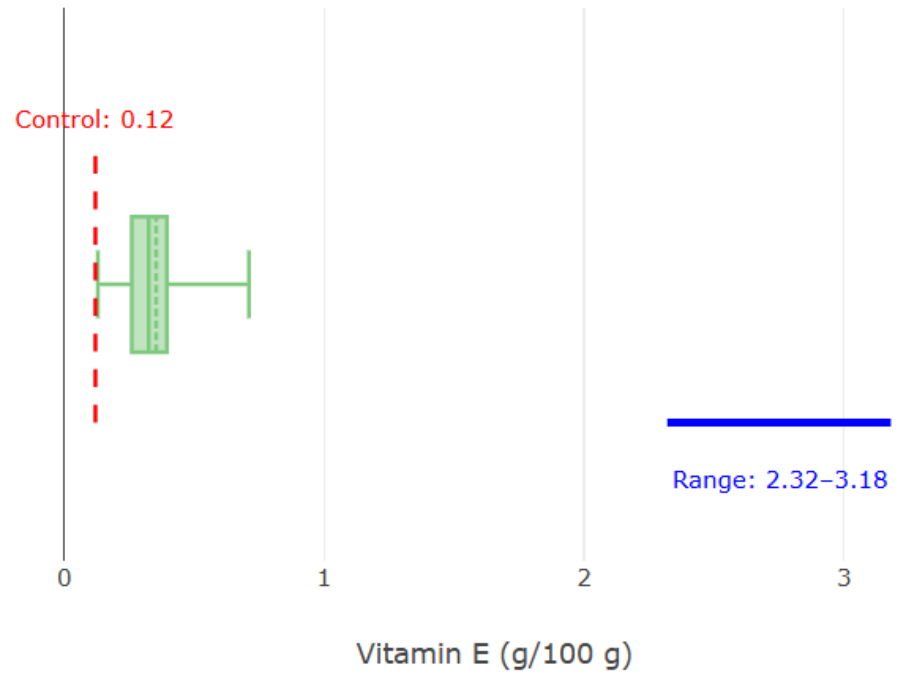
Nutritional composition – where does the Guinea-Bissau rice stands?

Vitamins

Vitamin B3 in Rice Varieties

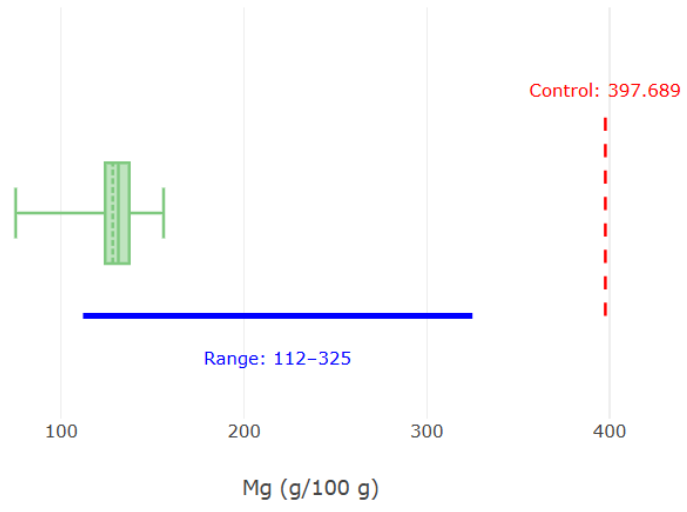


Vitamin E in Rice Varieties

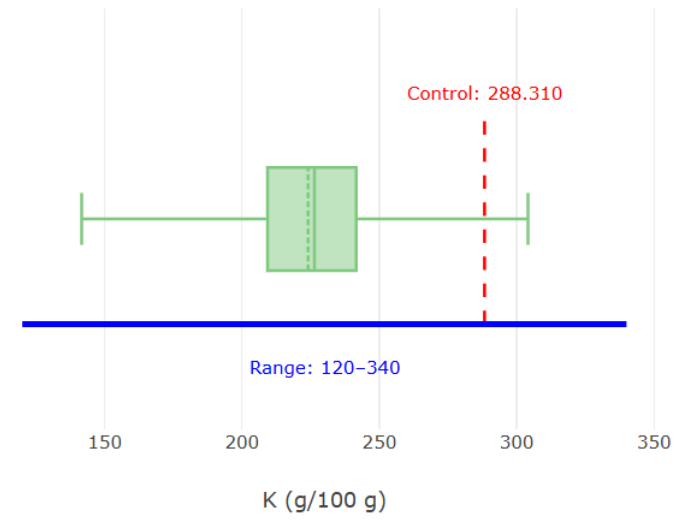


Minerals

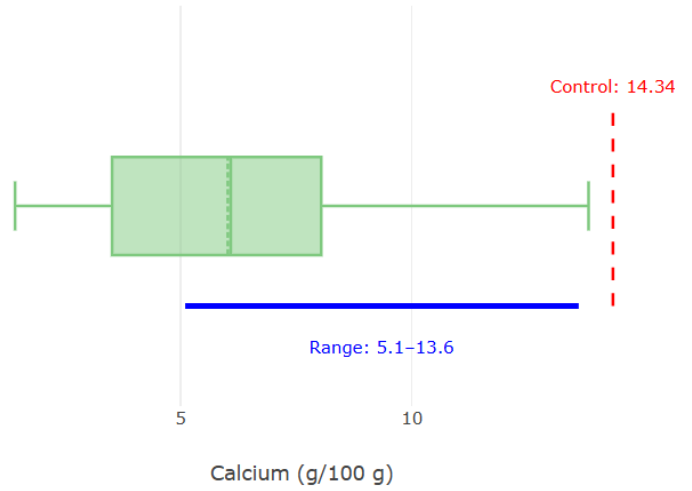
Magnesium (Mg) in Rice Varieties



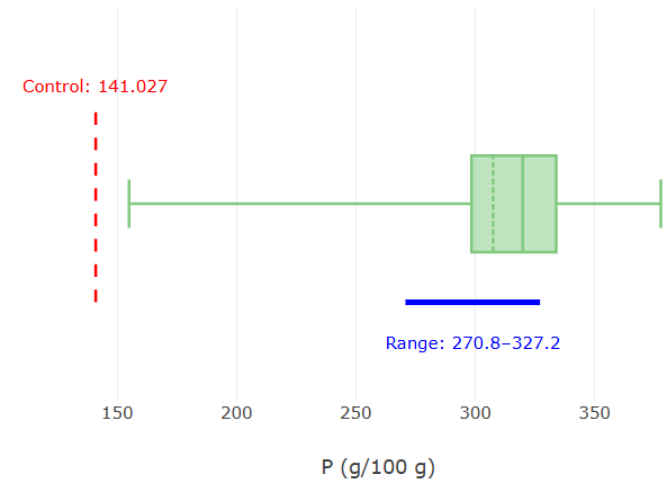
Potassium (K) in Rice Varieties



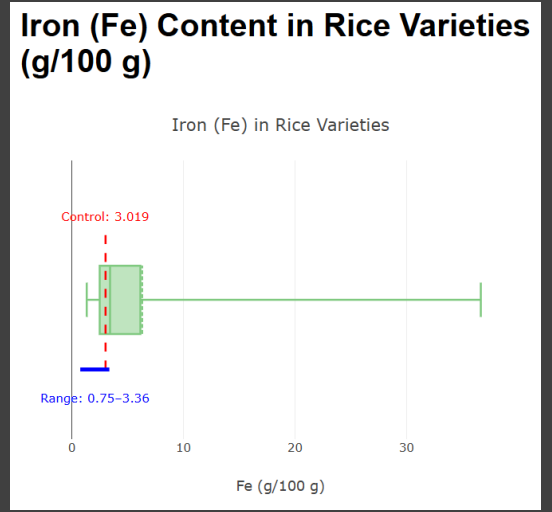
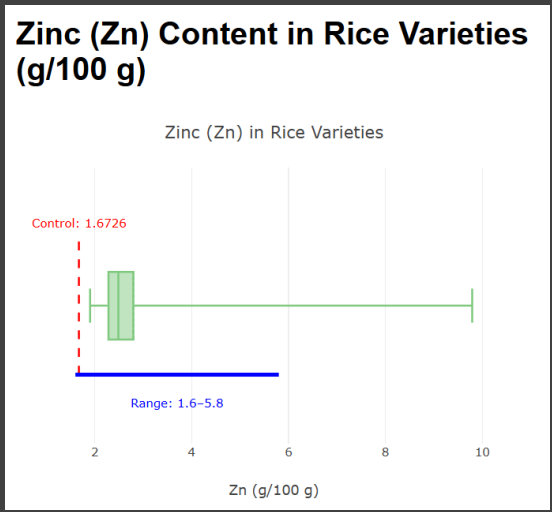
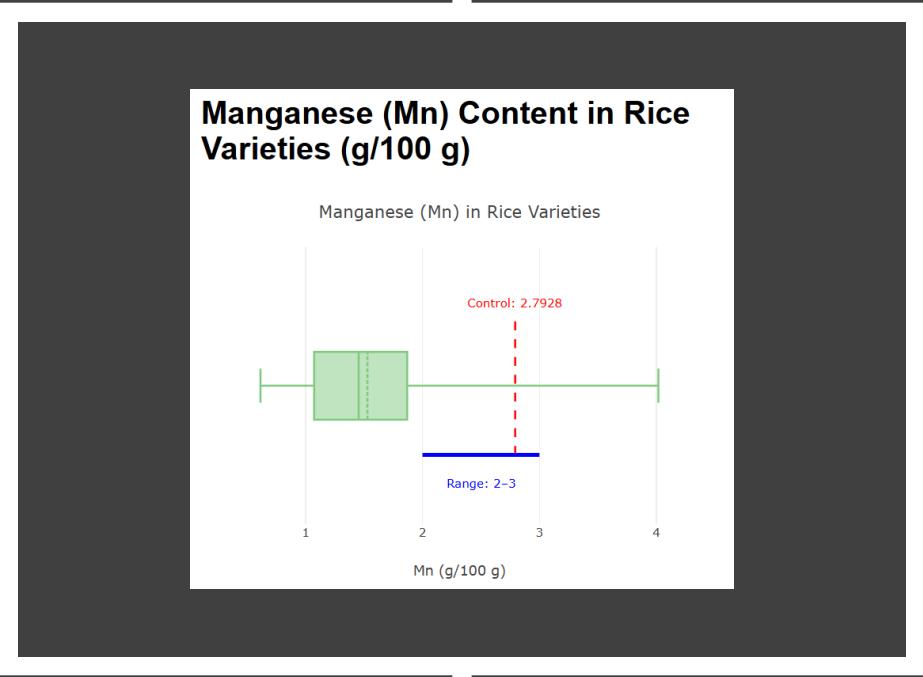
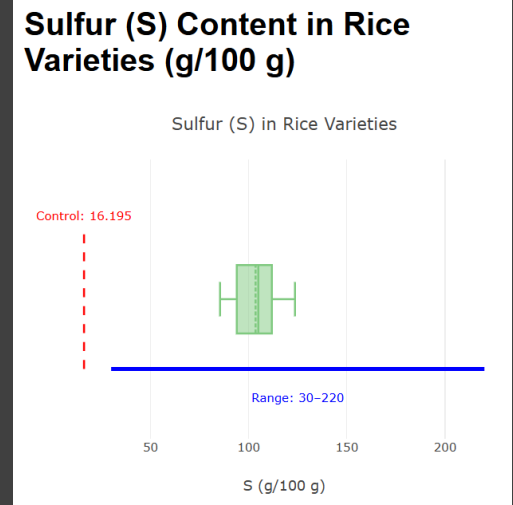
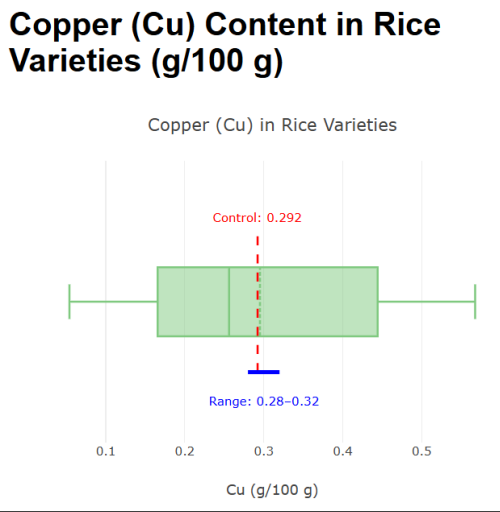
Calcium in Rice Varieties



Phosphorus (P) in Rice Varieties

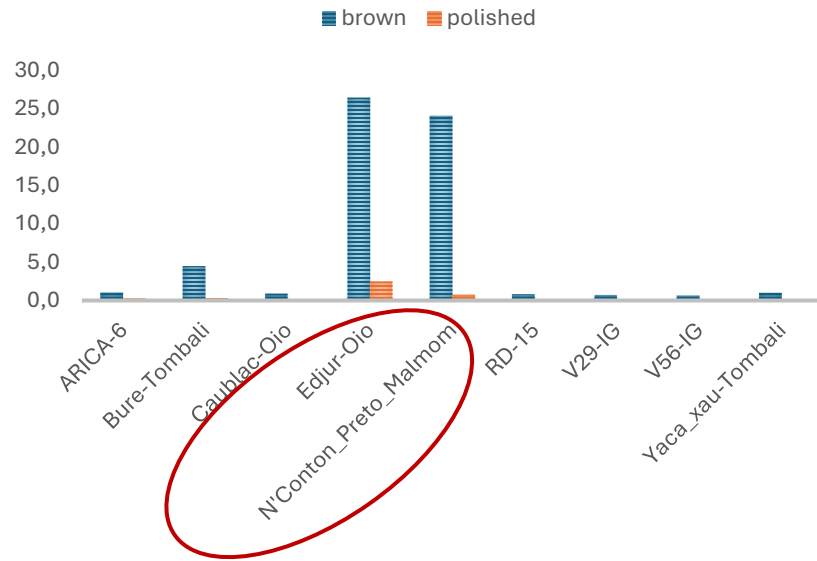


Minerals

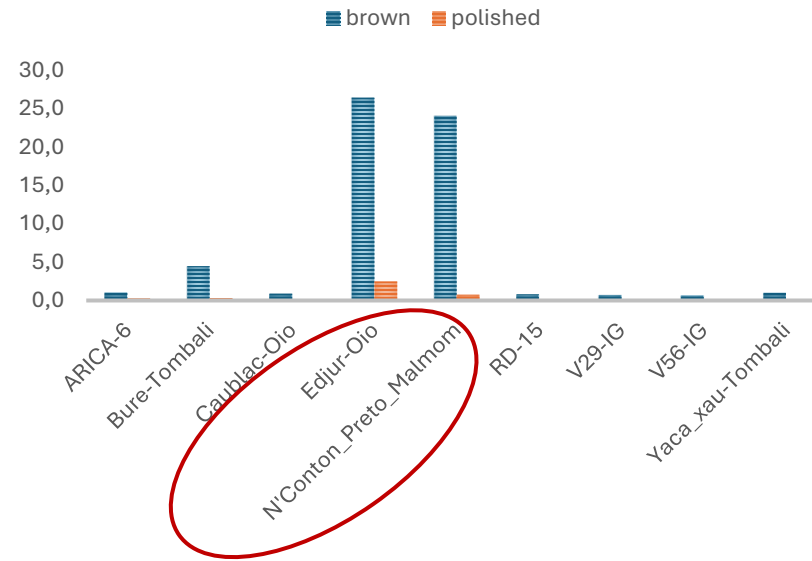


Antioxidant capacity: higher in *Oryza glaberrima* varieties

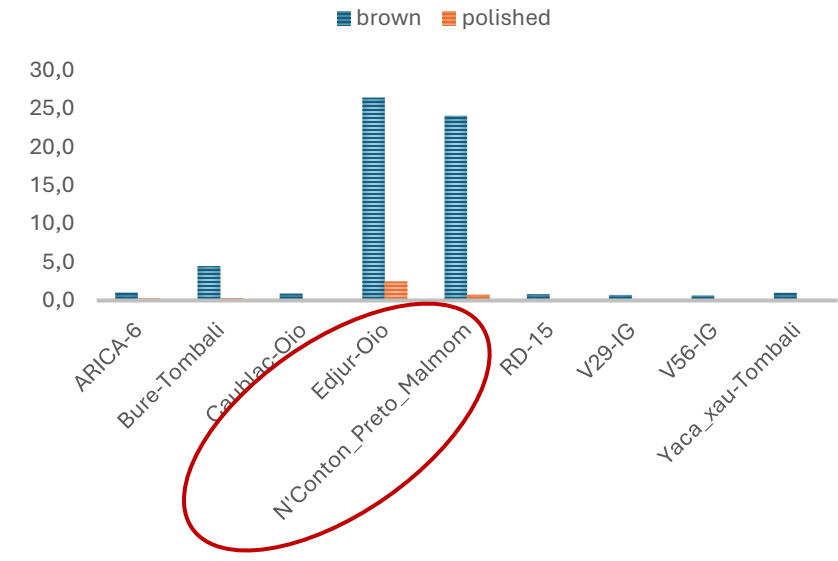
ANTIOXIDANTS - FRAP



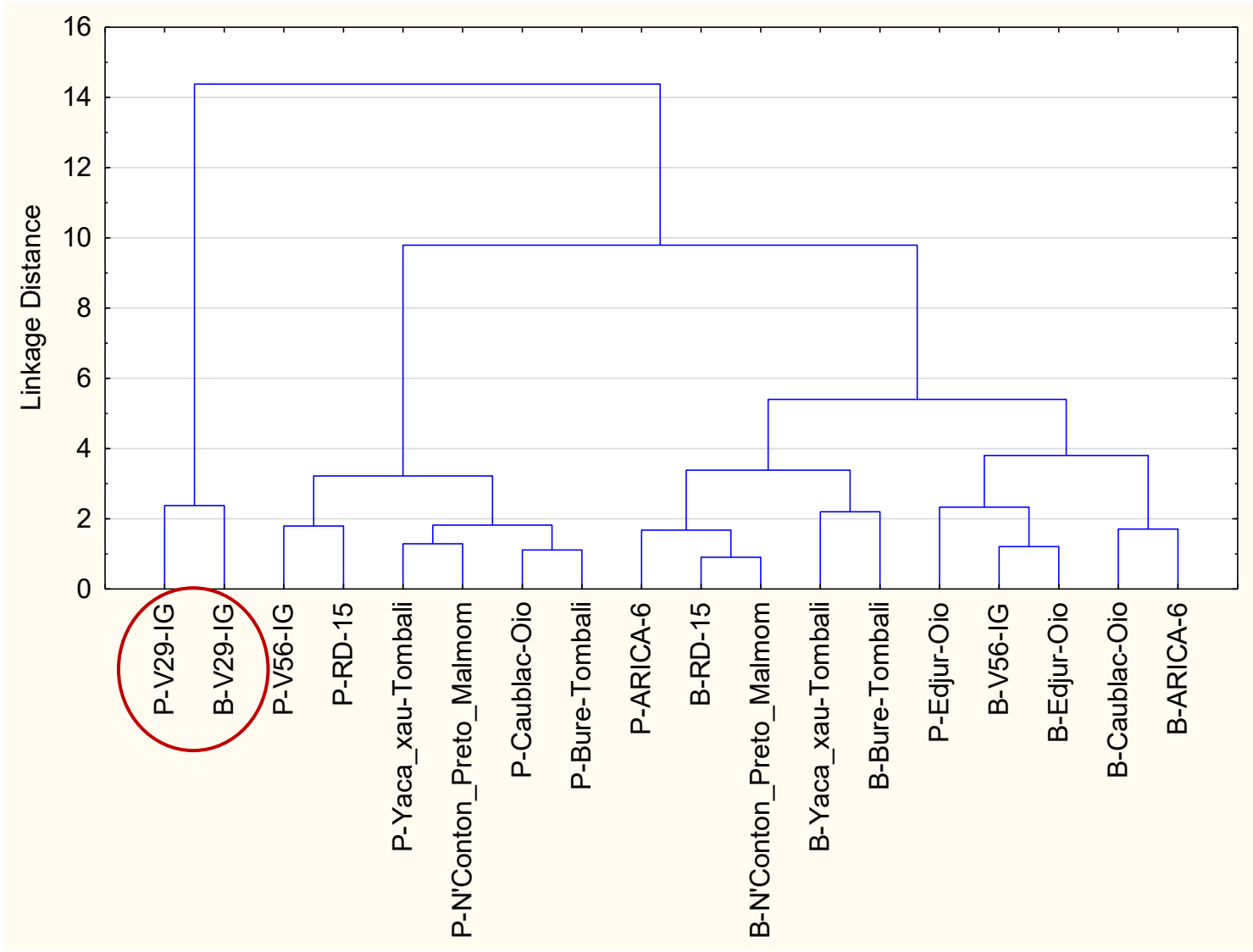
ANTIOXIDANTS - DPPH



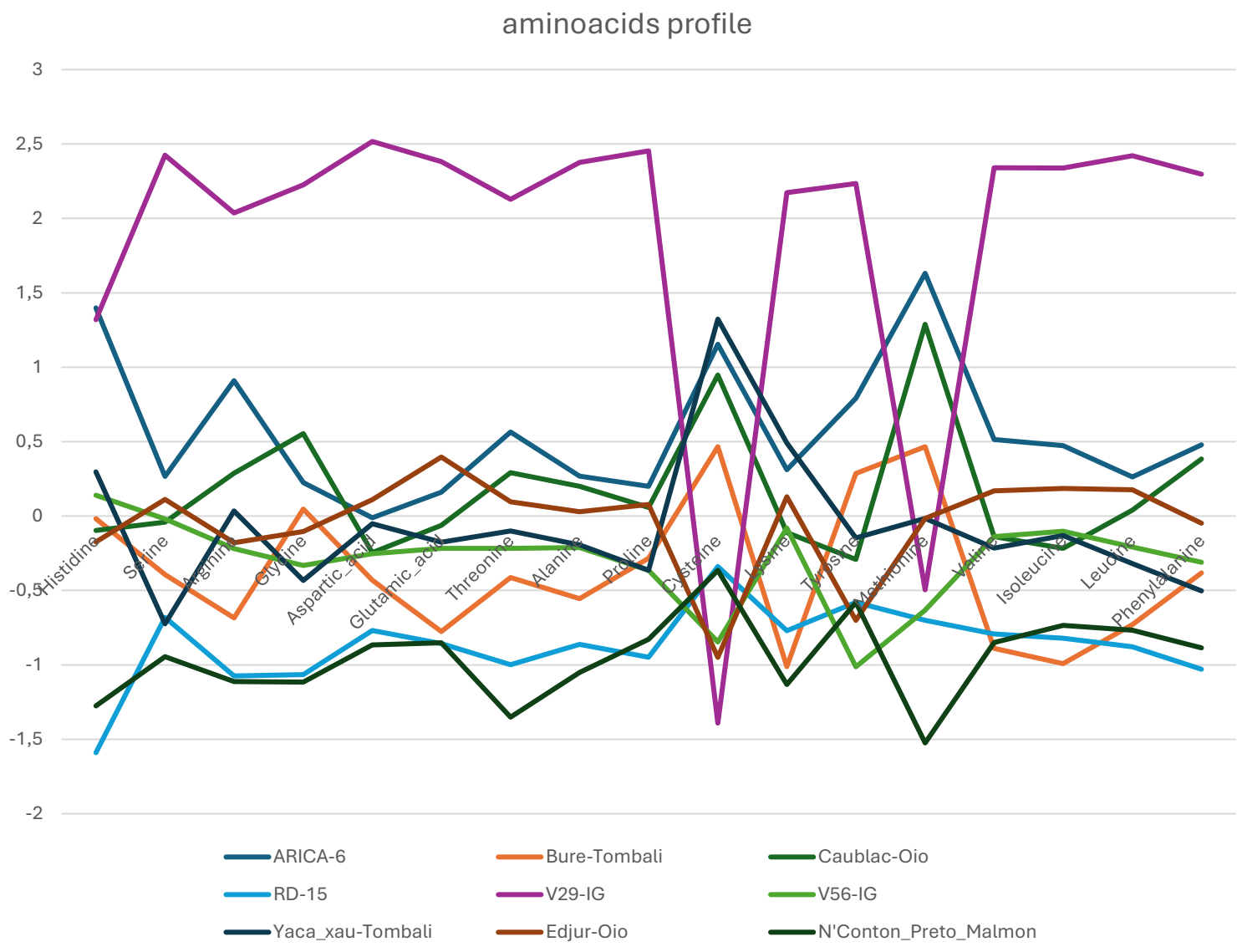
ANTIOXIDANTS - DPPH



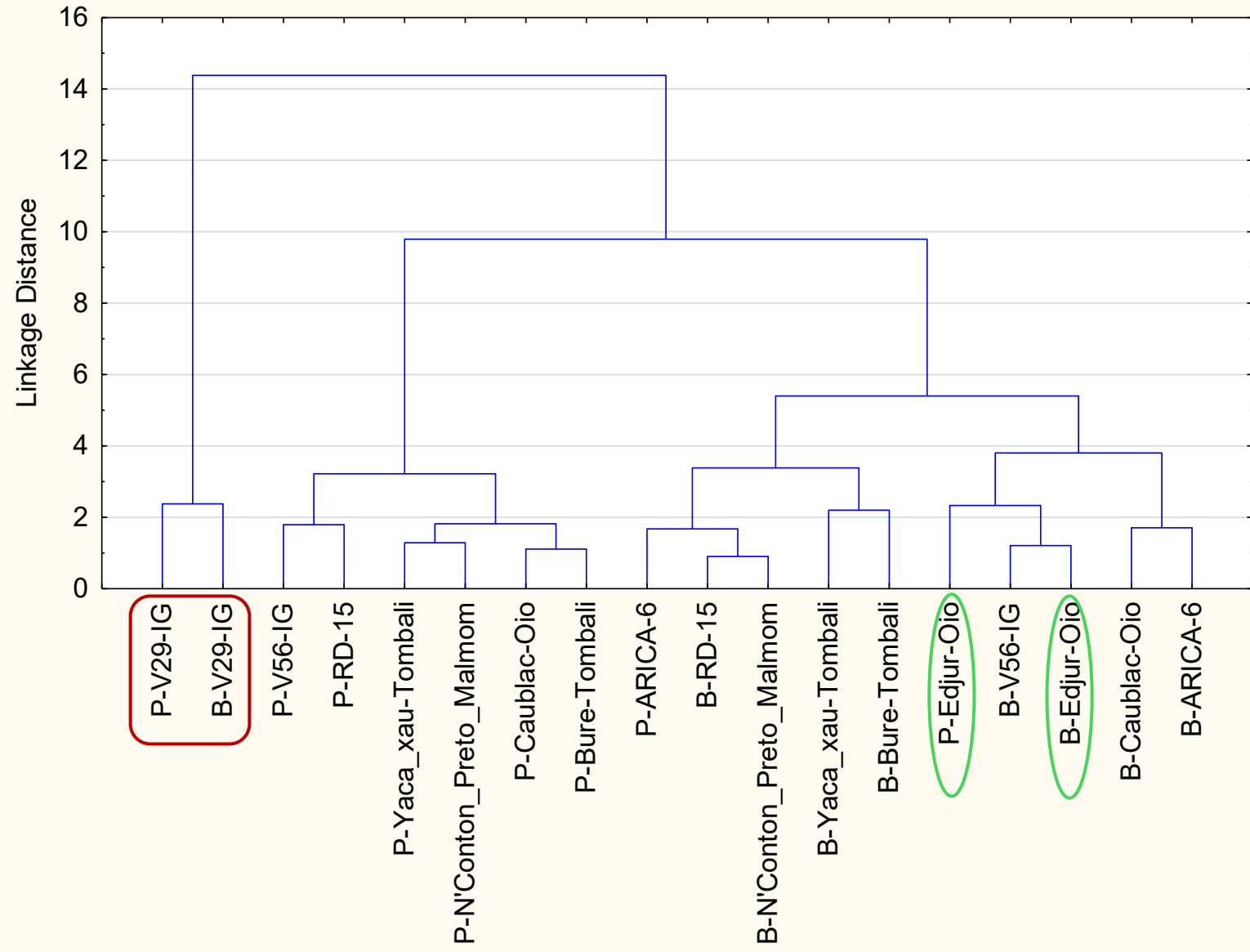
Functional analyses



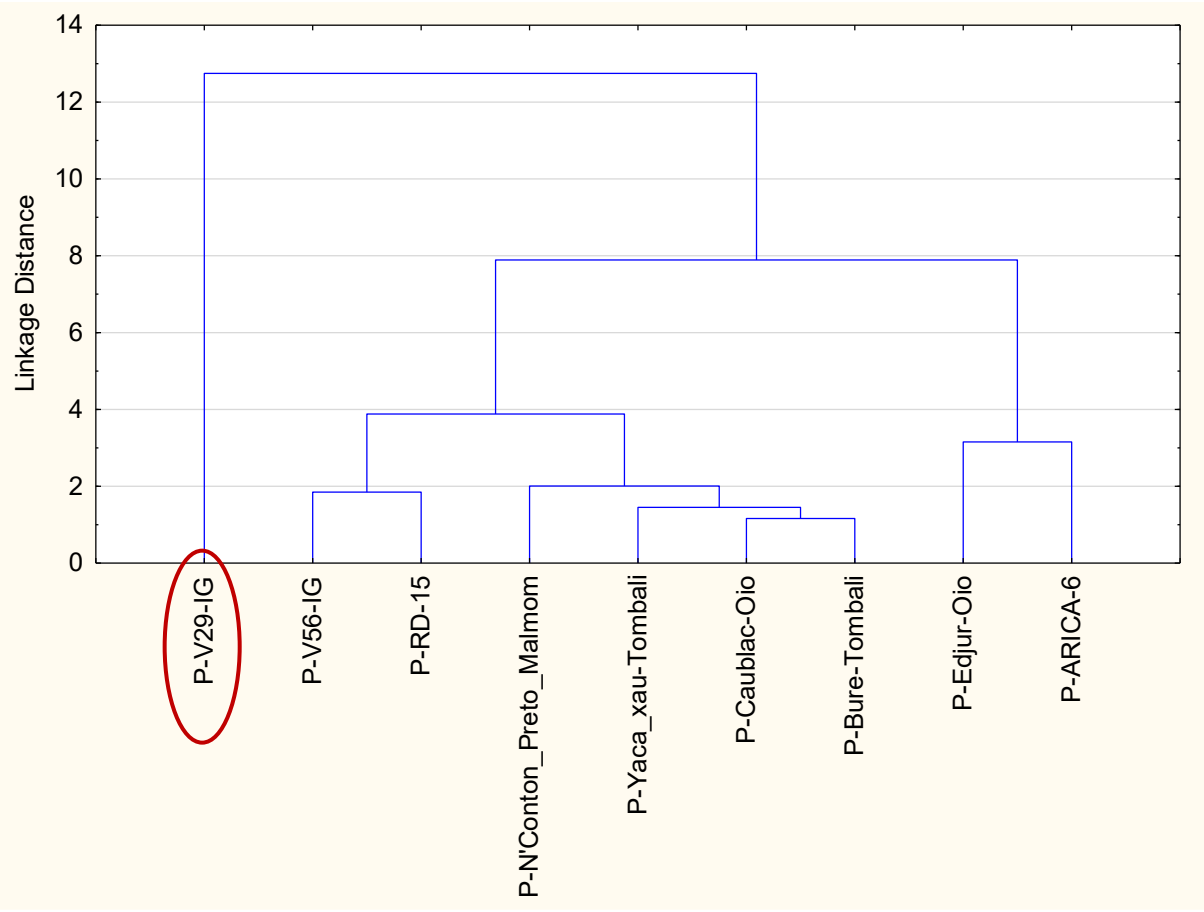
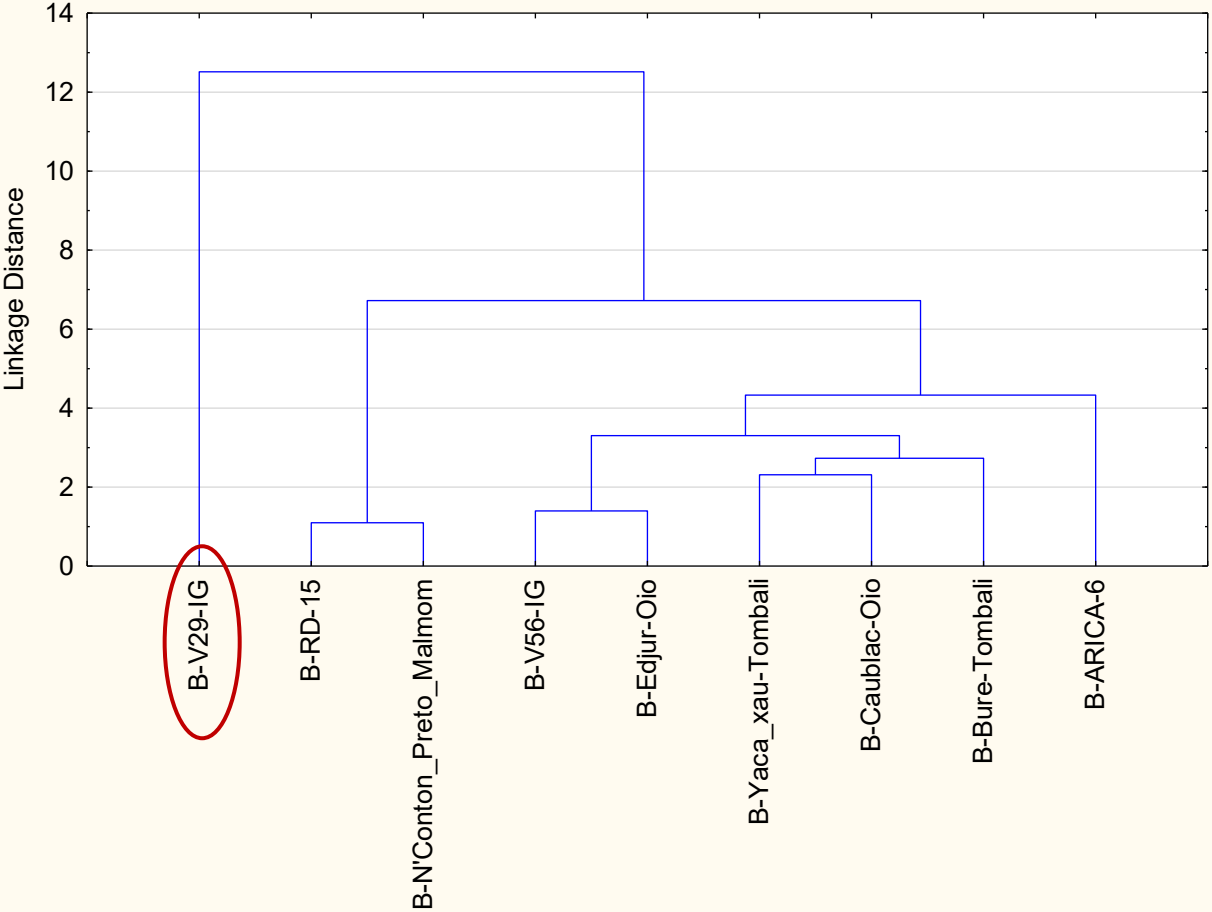
Amino acids profile



Amino acids profile



Amino acids profile



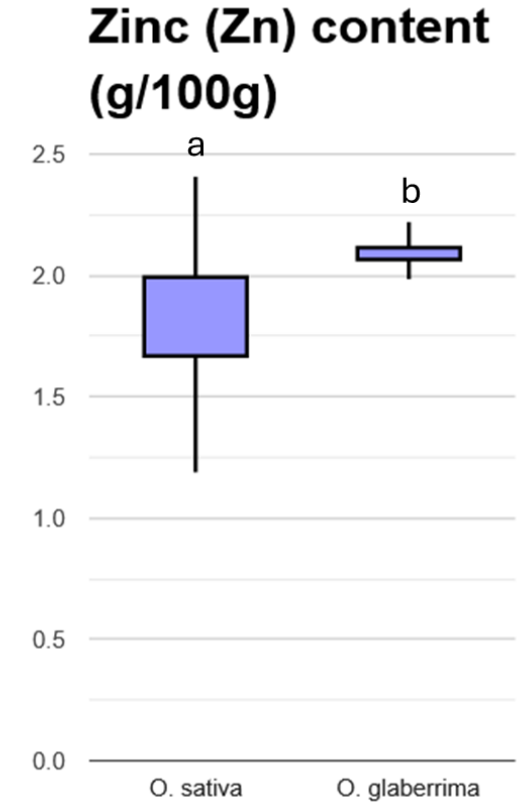
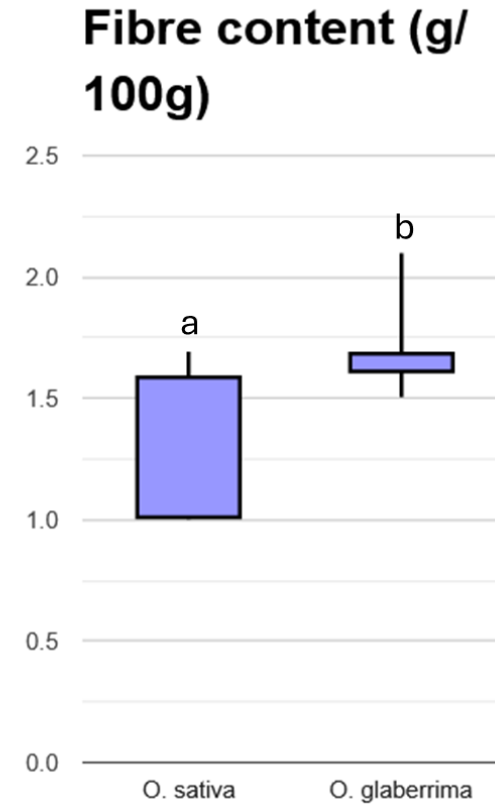
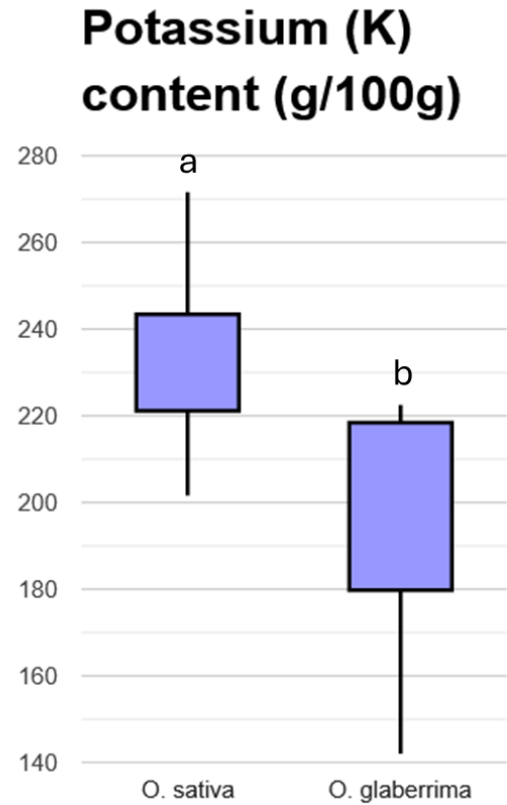
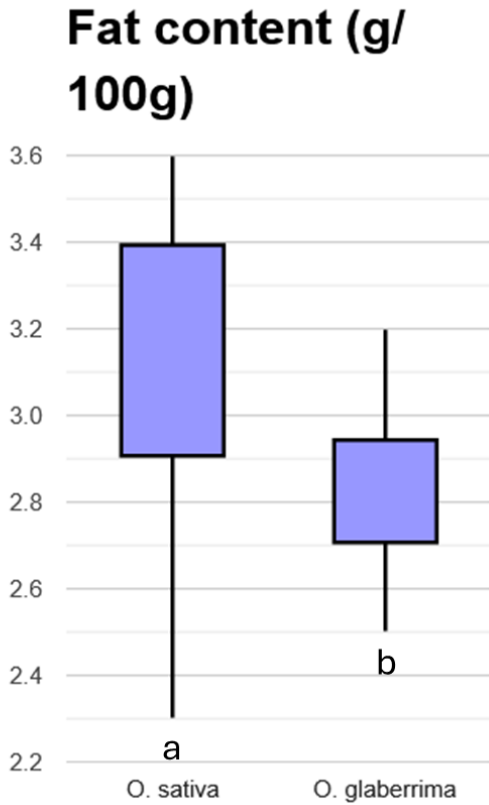
Highlighted varieties

- **RD-15-IG, V56-IG, Caublac-Oio, N'Conton Preto** → low protein content
- **Aninha** → low fat content
- **Icai(s)** → low fibre content
- **ARICA-6** → low vitamin B1 and vitamin B2 content
- **RD-15, VG29-IG, V56-IG** → high vitamin B3 content
- **Malu-Raça-Bissau** → high Fe content
- **Aferenque** → high Zn content
- Globaly, **all varieties** are very high in P and S

Is there a difference between species and regions?

Nutritional composition – Differences between species?

Mann Whitney U test
(Wilcoxon rank-sum)
 $n = 21, 8$



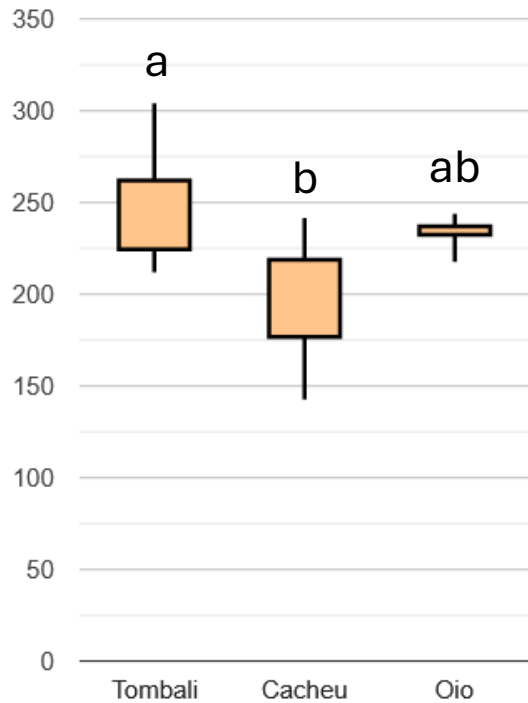
Brown

Polished

Nutritional composition – Differences between regions?

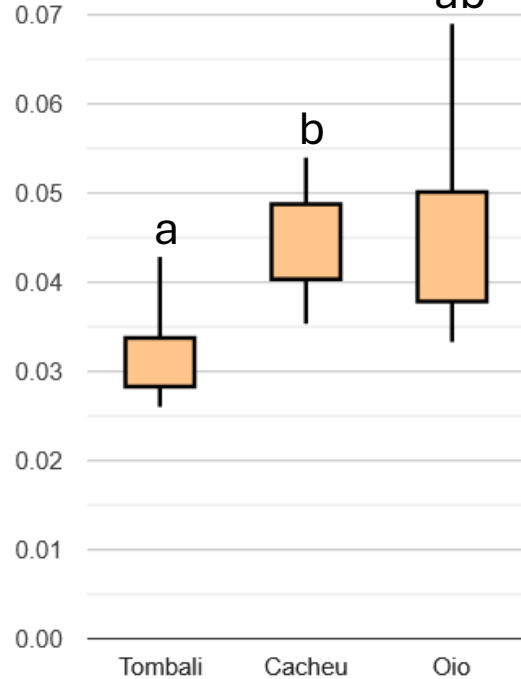
Kruskal-Wallis-test
Sidak correction
Dunn's multiple comparisons
 $n = 10, 10, 7$

Potassium (K) content (g/100g)

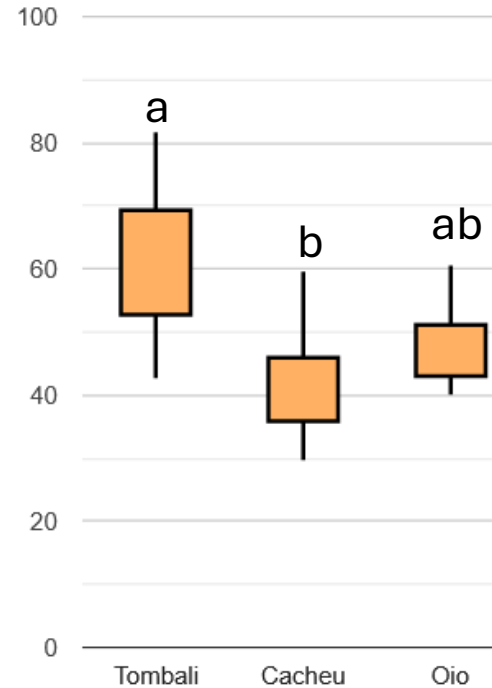


Brown

Vitamin B2 content (g/100g)

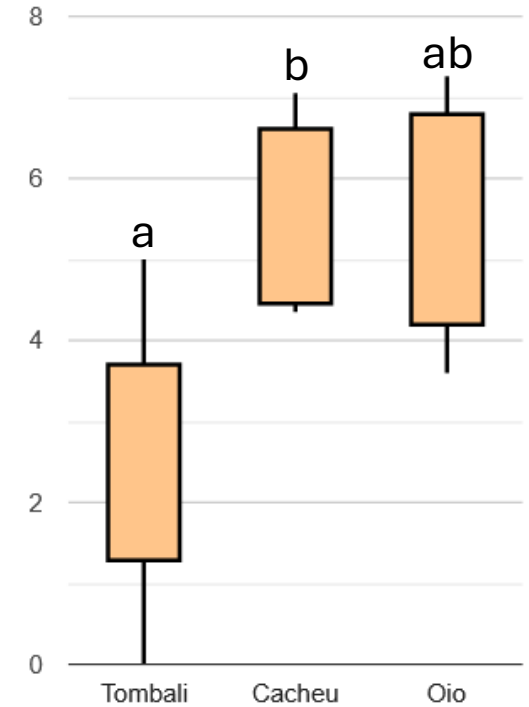


Potassium (K) content (g/100g)



Polished

Calcium (Ca) content (g/100g)



Nutritional composition – Differences? (additional candidates)

Differences between species?

Brown samples:

- P content

Polished samples:

- Vitamin B2 content
- Vitamin B3 content

❖ **Degree of polishing**

Differences between regions?

Brown samples:

- Starch content (Cacheu / Oio)

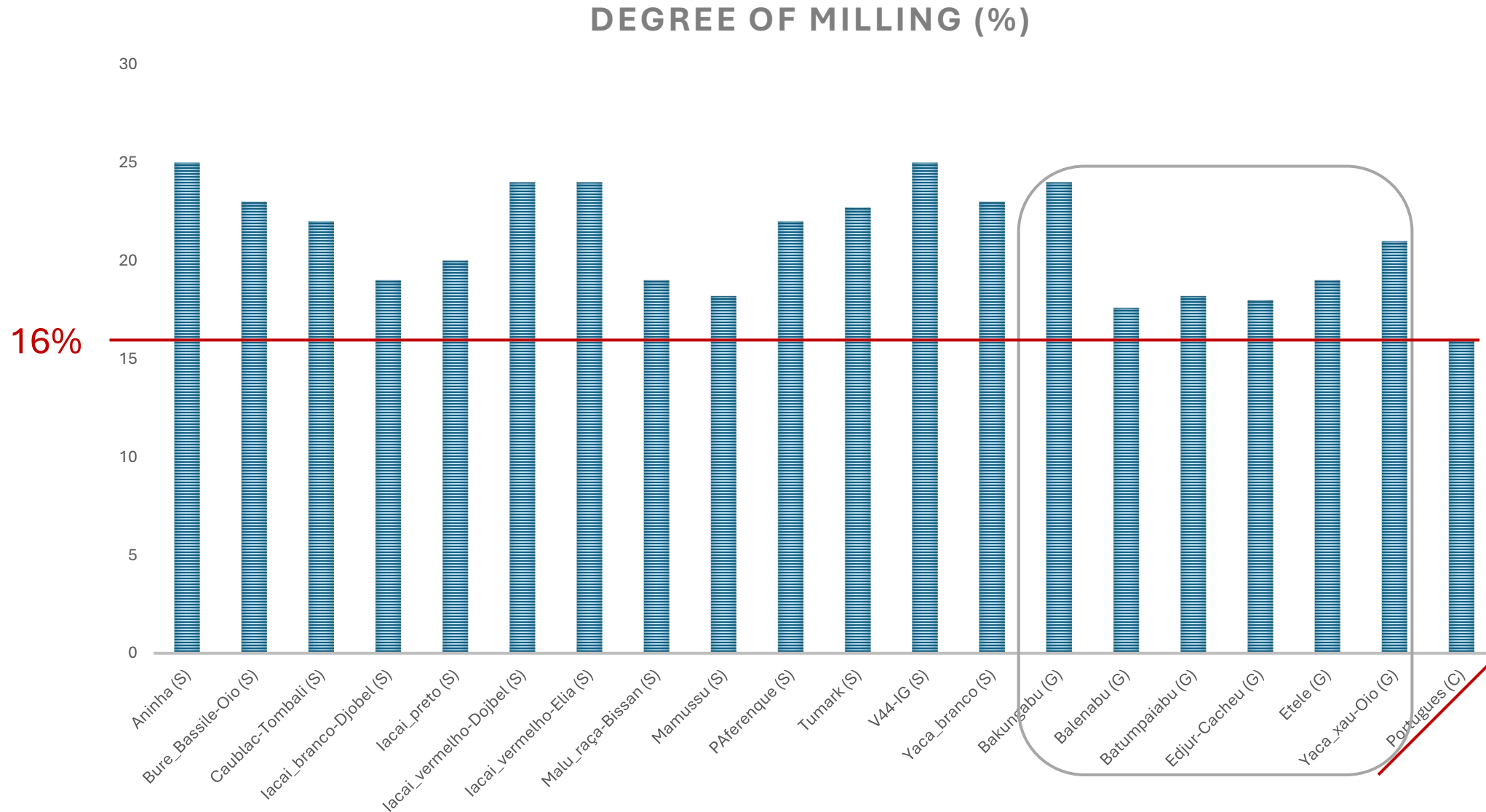
Polished samples:

- Vitamin B2
- Mg content

What is the effect of polishment?

High mass losses during polishing

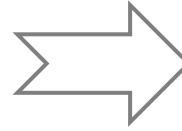
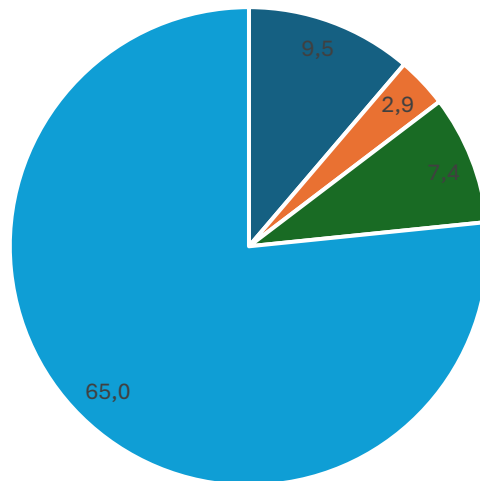
On average **21%** of the total mass is lost



Nutrient losses after polishing

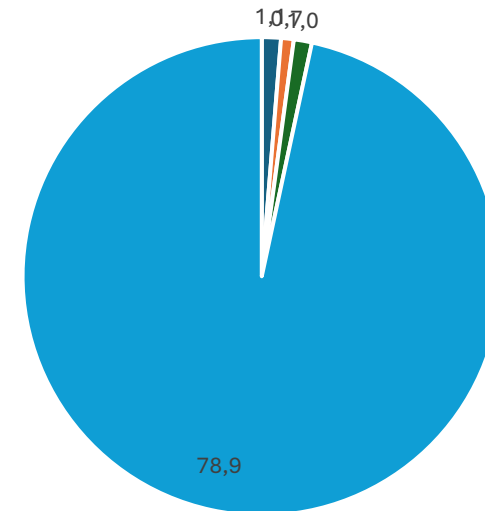
Brown

V44-IG - Macronutrients (brown rice)



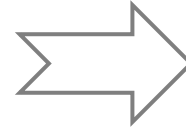
Polished

V44-IG - Macronutrients (polished rice)



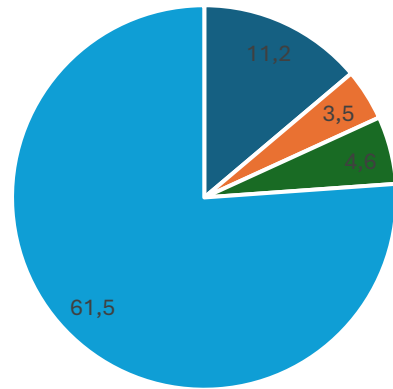
Nutrient losses after polishing

Brown

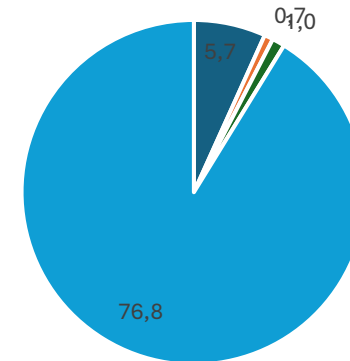


Polished

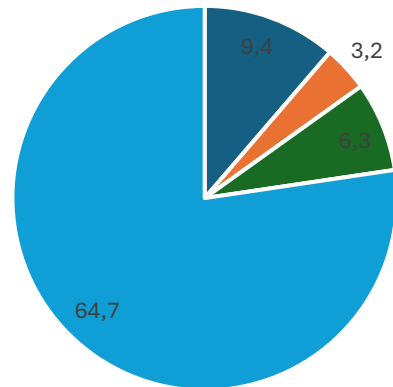
Bure_Bassile-Oio - Macronutrients (brown rice)



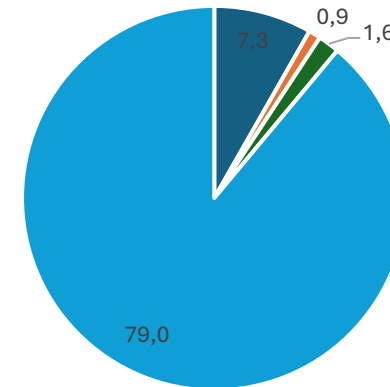
Bure_Bassile-Oio - Macronutrients (polished rice)



Yaca_xau-Oio - Macronutrients (brown rice)

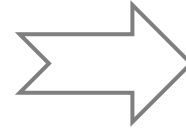


Yaca_xau-Oio - Macronutrients (polished rice)



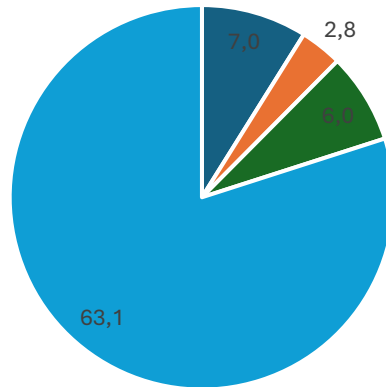
Nutrient losses after polishing

Brown

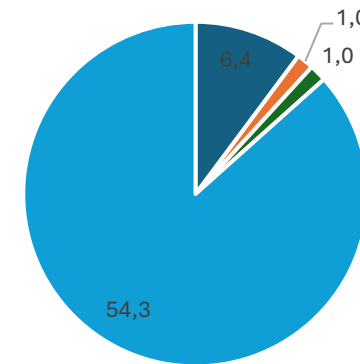


Polished

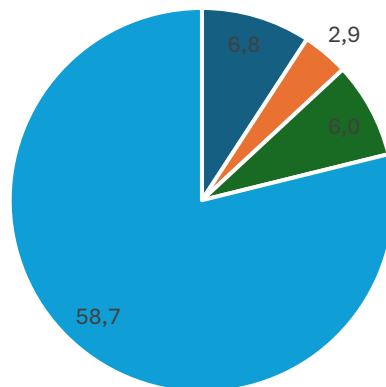
N'Conton_Preto - Macronutrients (brown rice)



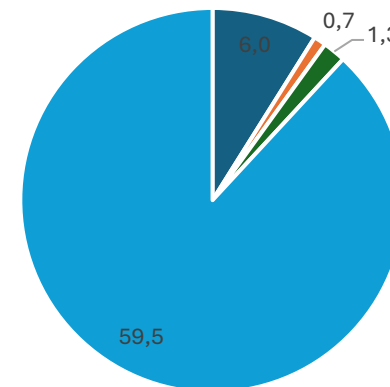
N'Conton_Preto - Macronutrients (polished rice)



RD-15 - Macronutrients (brown rice)



RD-15 - Macronutrients (polished rice)



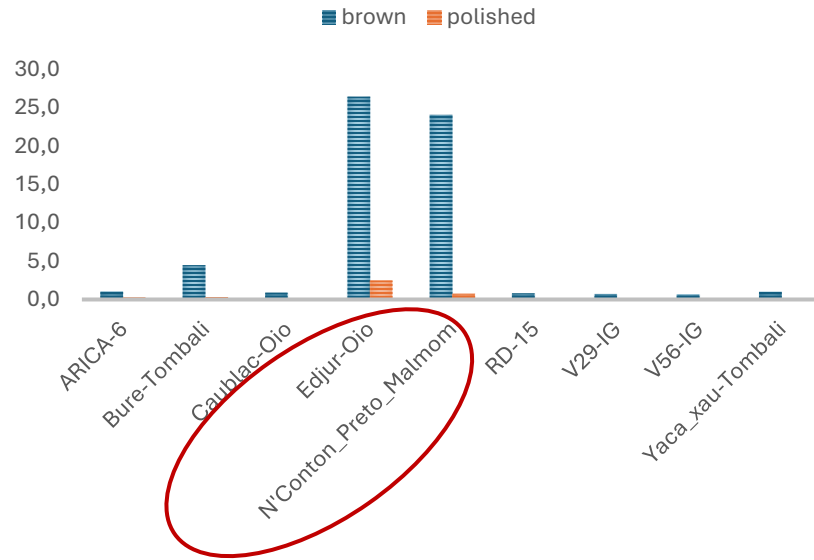
Nutrient losses after polishing

	general range			general range
Protein	10% - 20%		K	70% - 80%
Fat	65% - 80%		Ca	0% - 70%
Fibre	70% - 80%		Mg	75% - 90%
Starch	8% - 20%		P	65% - 75%
			S	10% - 20%
Vitamin-B1	65% - 100%		Fe	30% - 70%
Vitamin-B2	90% - 100%		Cu	0% - 50%
Vitamin-B3	70% - 100%		Zn	20% - 30%
Vitamin-E	85% - 100%		Mn	50% - 65%

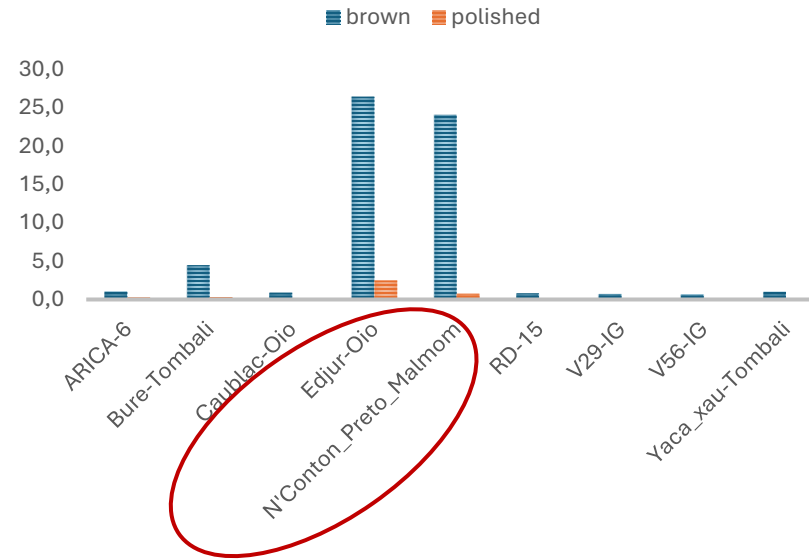
Antioxidant capacity: higher in *Oryza glaberrima* varieties

Huge losses after polishing

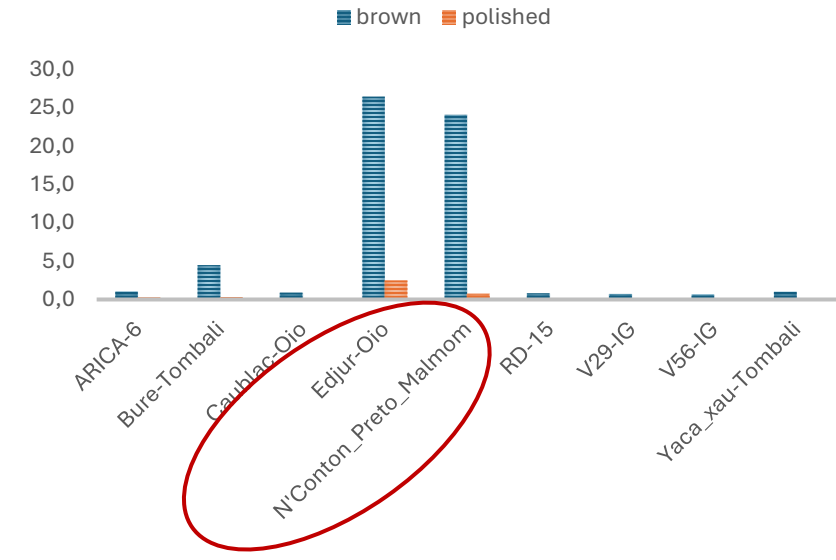
ANTIOXIDANTS - FRAP



ANTIOXIDANTS - DPPH



ANTIOXIDANTS - DPPH



Implications:

- Local preferences for specific varieties has an impact on diets and need to introduce other foods to assure food security
- Considering specific varieties can be beneficial to mitigate hidden hunger
- Polishing leads to major losses both in mass and nutritional value

THANK
YOU!

