Supplementary Tables

Table 1: Suitability of screening methods. Assays marked in bold have Reliability scores >90.

Assay	Reproducibility	Repeatability	Accuracy	Reliability
Ninhydrin	96.8	95.2	99.1	97.0
Bradford	92.2	95.6	98.9	95.6
BCA	92.2	95.1	96.7	94.7
Pierce 660	89.5	93.9	91.8	91.8
Biuret	98.1	92.2	94.8	95.1
Lowry	96.4	92.5	93.4	94.1
Folin-Ciocalteu	95.6	97.4	96.3	96.4
Fast Blue	90.6	98.6	96.3	95.3
Prussian Blue	91.1	96.9	97.9	95.3
Lever	90.1	90.2	95.8	92.1
Anthrone	76.5	91.1	91.2	86.5
Phenol-Sulphuric	51.8	93.9	77.8	76.5

Table 2: False positive response expressed as %. Values marked in bold represent violations of the 1 % tolerance

Assay	Gallic acid	Glucose	BSA
Bradford	0.2±0.1	**3.0±1.4**	-
Ninhydrin	0.7±0.4	0.3±0.2	-
Prussian Blue	-	5.2±1.6	**18.1±2.5**
Folin-Ciocalteu	-	**1.2±0.1**	0.4±0.1
Fast Blue	-	0.7±0.0	0.9±0.1
Lever	0.9±0.0	-	0.1±0.1

Table 3: Assay specificity in a three-standard mixture

Assay	Sample	Slope	y-intercept	p-value
Ninhydrin	Standard	48.6	3.4	0.93
	Mixture	48.1	3.6	
Lever	Standard	2.7	0.2	1.00
	Mixture	2.8	0.2	
Fast Blue	Standard	2.7	-0.1	0.98
	Mixture	2.7	-0.1	

'Standard' refers to the single appropriate compound used to produce the standard curve.
'Mixture' refers to the three-standard mixture

Table 4: Previous publications on leaf protein extraction

Plant	Extraction	Purification	Recovery	Purity	Protein
Bean[1]	Alkali	Acid	11.2	69.2	29.7
Cabbage[1]	Alkali	Acid	6.2	63.9	20.6
Tomato[1]	Alkali	Acid	9.6	62.6	28.0
Water Hyacinth[2]	Alkali	Acid	37.3	49.6	27.8
Sugarcane[1]	Alkali	Acid	10.3	48.0	6.0
Safflower[3]	Alkali	Acid	10.2	94.9	47.0
Safflower[3]	Alkali	Acid	10.7	88.5	47.0
R. rubiginosa[4]	Alkali	Ultrafiltration	90.0	80.0	24.6
Switchgrass[5]	Enzyme	None	41.1	6.2	15.0
Oolong Tea[6]	Alkali	Acid	85.0	52.0	55.3
Lucerne[7]	Juicing	Ultrafiltration	8.2	88.7	21.5
Tobacco[8]	Juicing	Acid	17.0	50.0	12.0
Lucerne[9]	Juicing	Acid	6.0	73.9	20.9
Jatropha curcas[10]	Alkali	None	36.8	87.5	25.9
Jatropha curcas[10]	Alkali	None	38.9	76.4	24.4
Sugarbeet[11]	Juicing	Heat	7.0	35.7	10.0
Palm[12]	Enzyme	None	62.0	68.8	14.9
Orchard Grass[13]	Juicing	Acid	20.6	34.0	17.1
Lucerne[14]	Juicing	Acid	19.0	68.8	18.2
Lucerne[15]	Juicing	None	40.0	27.3	20.5
Coconut[16]	Alkali	Ultrafiltration	40.6	51.8	7.8
Brewers' Spent[17]	Alkali	None	21.4	60.2	21.9
Lucerne[18]	Ultrasound	Ultrafiltration	13.21	91.1	25.0
Lucerne[18]	Alkali	Acid	10.4	74.5	25.0
Lucerne[18]	Juicing	Heat	10.6	63.9	25.0
Sugarbeet[19]	Juicing	Acid	25.0	59.8	10.0
Soy Meal[20]	Alkali	None	17.3	43.4	61.2
Sesame[21]	Salt Solution	Acid	49.6	97.0	52.0
Sesame[21]	Alkali	Acid	60.4	95.5	52.0
Lucerne[22]	Juicing	Heat	38.9	42.5	20.1
Lucerne[23]	Juicing	Fermentation	29.9	57.2	22.5
Lucerne[24]	Juicing	Heat	27.0	53.6	21.5
Lucerne[24]	Juicing	Heat	26.2	51.6	21.5
Ryegrass+White Clover[25]	Juicing	None	23.4	70.5	20.5

Ryegrass+White Clover[25]	Juicing	None	20.3	68.0	16.8
Ryegrass+White Clover[25]	Juicing	None	18.5	65.2	25.4
Lucerne[25]	Juicing	None	23.2	52.6	25.6
Lucerne[25]	Juicing	None	22.7	39.4	23.4
Lucerne[26]	Juicing	Heat	42.9	57.6	20.4
Soy Meal[27]	Enzyme	Acid	28.1	91.4	60.6
Winged Bean[28]	Alkali	Ultrafiltration	68.0	71.5	40.00
Sugarbeet[29]	Juicing	Acid	37.6	69.5	14.8
Soy[30]	Enzyme	None	28.0	56.0	31.7
Water Hyacinth[31]	Alkali	Acid	9.5	55.4	22.6
Ryegrass[32]	Juicing	Acid	23.8	46.3	18.2
Lucerne[32]	Juicing	Acid	17.1	46.1	16.7
Oolong Tea[33]	Alkali	None	23.0	52.7	52.8
Black Tea[33]	Alkali	None	42.0	48.5	48.5
Green Tea[33]	Alkali	None	26.2	46.1	46.1
Chickpea[34]	Alkali	Acid	74.0	86.3	25.8
Chickpea[34]	Salt Solution	Centrifugation	56.0	81.5	25.8
Faba Bean[34]	Alkali	Acid	66.2	75.2	30.7
Fenugreek[34]	Alkali	Acid	63.9	69.6	30.7
Fenugreek[34]	Enzyme	Centrifugation	28.2	62.4	30.7
Fenugreek[34]	Salt Solution	Centrifugation	52.5	60.8	30.7
Faba Bean[34]	Enzyme	Centrifugation	30.8	60.4	30.7
Faba Bean[34]	Salt Solution	Centrifugation	53.0	59.5	30.7
Chickpea[34]	Enzyme	Centrifugation	24.3	59.3	25.8
Groundnut[35]	Alkali	Acid	28.4	79.4	26.0
Sweet Potato[36]	Juicing	Solvent	48.4	83.4	3.5

Table 5: Mean protein content of plants used in previous literature.

Plant	**Protein**
Soy Meal	60.9±0.4
Oolong Tea	54±1.8
Sesame	52±0
Black Tea	48.5±0
Safflower	47±0
Green Tea	46.1±0
Lupin	43.8±0
Winged Bean	40±0
Soy	31.7±0
Sunflower	31.7±0
Faba Bean	30.7±0
Fenugreek	30.7±0
Bean	29.7±0
Tomato	28±0
Groundnut	26±0
Chickpea	25.8±0
Water Hyacinth	25.2±3.6
Jatropha curcas	25.1±1.1
R. rubiginosa	24.6±0
Brewers' Spent	21.9±0
Lucerne	21.9±2.6
Ryegrass+White Clover	20.9±4.3
Cabbage	20.6±0
Ryegrass	18.2±0
Orchard Grass	17.1±0
Switchgrass	15±0
Palm	14.9±0
Sugarbeet	14.8±0
Tobacco	12±0
Gorse	11.6±0
Broom	11.2±0
Fireweed	10.5±0
Sugarbeet	10±0
Coconut	7.8±0
Sugarcane	6±0
Sweet Potato	3.5±0
Cauliflower	2±0

Values expressed in $\%g.g^{-1}$ dry plant mass

Table 6: Amino acid profile of LPCs

Ref	Extraction	Purification	Protein	Ala	Arg	Asp	Glu	Gly	His	Ile	Leu	Lys	Met	Phe	Pro	Ser	Thr	Tyr	Val
[37]	Juicing	Acid	57.2	6.1	6.6	10.5	11.6	5.5	2.6	6.0	9.7	6.6	1.8	6.4	4.7	4.7	5.3	4.8	7.2
[37]	Juicing	Acid	60.1	6.9	6.5	9.4	11.0	6.0	2.3	6.0	10.1	6.8	2.3	6.8	5.9	4.7	5.0	4.6	6.8
[37]	Juicing	Acid	53.6	6.8	6.4	9.4	11.2	5.9	2.6	6.2	9.9	6.1	2.2	7.0	4.7	4.5	5.6	4.7	7.0
[19]	Juicing	Acid	59.8	5.6	7.2	9.8	12.9	4.7	2.9	4.4	9.7	7.6	2.4	6.3	5.3	3.7	5.5	5.7	6.3
[31]	Alkali	Acid	55.4	3.4	3.6	5.1	5.9	3.0	1.1	2.3	5.1	2.7	1.3	3.4	2.7	2.6	2.6	2.2	2.8
[38]	Alkali	Acid	46.8	8.3	6.9	13.9	15.9	7.4	2.3	7.0	13.2	8.8	2.9	7.7	6.9	3.7	5.9	6.1	9.3
[39]	Juicing	Solvent	50.0	5.2	5.4	12.0	10.0	4.5	2.0	4.0	7.8	5.5	1.8	5.3	3.3	4.7	4.2	4.1	5.2
[3]	Alkali	Acid	88.5	5.5	12.7	14.2	26.3	5.6	3.0	4.4	7.8	2.8	2.3	5.8	5.1	5.2	3.4	4.0	6.1
[3]	Alkali	Acid	94.9	5.4	12.3	14.9	28.1	6.0	3.1	4.6	8.0	2.3	2.3	5.9	4.9	5.3	3.6	4.1	6.4
[40]	Juicing	Acid	68.6	6.4	8.3	10.3	12.6	5.7	3.4	5.3	9.7	6.9	2.6	6.6	4.8	2.8	5.7	5.4	6.9
[30]	Enzyme	None	56.0	4.1	7.1	11.5	21.2	4.2	2.3	5.4	7.6	5.8	1.8	5.5	5.1	5.1	3.4	3.9	5.2
[41]	Juicing	Acid	69.8	6.7	7.8	10.8	13.2	5.9	3.3	5.7	10.2	6.3	2.6	7.0	4.3	3.6	5.9	5.6	7.2
[21]	Alkali	Acid	95.5	4.0	11.5	7.0	14.5	3.9	2.5	4.0	6.7	2.4	3.2	4.8	5.9	4.3	3.6	3.9	4.9
[21]	Salt Solution	Acid	97.0	4.2	11.2	8.0	13.5	4.0	2.6	4.1	6.6	2.2	2.1	4.6	5.7	4.1	3.7	3.6	5.2
Gorse	Enzyme	Solvent	96.9	7.8	6.0	12.7	12.8	7.6	1.7	2.4	8.6	6.8	2.0	4.9	5.3	6.7	4.0	4.6	3.4
[42]	-	-	100.0	7.7	4.5	10.6	19.3	6.2	2.4	4.7	8.8	5.2	0.9	5.4	1.4	5.9	2.1	2.3	6.0
[43]	Alkali	Acid	80.0	10.9	4.9	6.5	23.8	2.2	2.1	4.6	13.1	3.4	2.7	7.7	5.1	5.2	2.8	2.9	5.6
[43]	Alkali	Acid	75.6	9.3	4.8	7.7	22.0	2.9	2.1	4.6	13.6	3.9	3.1	6.3	5.5	4.6	3.7	2.4	5.8
[33]	Alkali	None	46.1	6.0	3.4	11.6	12.4	5.9	1.9	6.3	9.0	2.8	1.9	4.4	4.8	4.3	3.1	4.3	5.5
[13]	Juicing	Acid	34.0	3.3	3.1	4.5	5.0	2.9	1.1	2.5	4.5	2.6	1.1	3.0	2.3	1.8	2.3	1.9	3.1
[10]	Alkali	None	76.4	5.5	14.2	12.5	11.2	5.1	3.5	4.5	7.1	3.0	1.7	5.4	5.5	5.2	3.6	3.2	5.2
[12]	Enzyme	None	68.8	4.8	10.0	9.3	15.9	4.7	2.9	4.8	7.3	3.5	3.7	4.8	3.5	3.8	4.2	4.2	6.0
[44]	Juicing	None	58.4	6.3	6.2	9.7	11.3	5.7	3.0	4.6	9.1	6.3	1.1	5.9	4.0	4.3	4.9	5.0	5.6
[45]	Juicing	Steam	60.7	3.3	3.8	5.8	6.3	3.1	1.5	2.6	5.2	3.9	1.1	3.4	3.0	2.8	3.1	2.8	3.4
[8]	Juicing	Acid	50.0	4.5	4.6	7.9	11.0	4.4	1.7	4.1	8.4	5.7	1.8	6.1	3.0	3.6	3.7	3.3	5.8
[37]	Juicing	Acid	63.1	6.1	6.6	10.1	11.1	5.4	2.6	6.2	10.0	6.2	2.1	6.6	6.0	4.4	5.3	4.7	6.8
[36]	Juicing	Solvent	83.4	3.7	8.5	12.3	6.4	3.4	2.7	3.8	5.0	8.3	1.7	5.8	3.3	4.0	4.5	4.0	5.6

Table 7: Variable Contribution for Amino acid PCA plots

Factors	Dim 1	Dim 2	Dim 3	Dim 4	Dim 5	Dim 6	Dim 7	Dim 8	Dim 9	Dim 10	Dim 11	Dim 12	Dim 13	Dim 14	Dim 15	Dim 16	Dim 17
Purity	1.03	25.82	0.48	1.71	4.77	17.52	6.90	1.44	9.74	3.11	0.08	24.55	0.31	0.79	0.48	0.19	1.07
Alanine	5.43	0.01	22.91	0.15	3.66	0.13	7.22	8.60	2.09	14.12	5.54	0.03	0.22	6.87	7.91	14.59	0.54
Arginine	4.00	9.59	19.12	0.63	0.86	1.45	0.03	0.33	4.29	5.48	13.14	8.11	0.65	3.84	8.24	0.39	19.85
Aspartic.Acid	6.97	0.44	2.66	13.88	0.03	5.71	3.66	12.03	6.93	16.86	8.91	14.12	0.64	3.66	1.05	0.00	2.47
Glutamic.Acid	5.04	12.90	6.07	0.10	2.05	2.87	0.65	12.10	16.04	25.81	1.61	0.47	1.19	1.71	0.02	9.63	1.74
Glycine	4.73	1.21	2.54	17.75	0.47	20.39	23.79	2.04	2.01	0.04	15.59	0.58	0.74	0.27	4.02	0.61	3.21
Histidine	7.95	1.85	5.54	0.22	9.05	6.82	0.21	8.37	3.98	0.14	18.16	3.40	10.08	0.02	4.77	7.73	11.71
Isoleucine	7.96	1.74	0.94	0.36	23.75	2.52	4.86	1.99	18.35	0.77	0.15	2.86	7.15	1.53	3.53	11.25	10.28
Leucine	7.22	0.70	17.90	1.12	0.63	0.13	2.00	1.81	1.38	0.89	0.00	0.44	0.14	8.33	0.16	30.11	27.02
Lysine	2.49	18.12	0.08	6.70	6.53	17.71	1.57	9.50	0.30	1.46	3.68	1.04	26.81	2.59	1.30	0.10	0.02
Methionine	4.74	1.01	0.14	27.72	1.90	0.33	7.74	28.44	11.39	6.70	1.45	1.19	2.59	0.95	1.55	1.10	1.06
Phenylalanine	9.63	0.62	3.10	0.16	0.18	10.00	2.74	0.18	1.66	1.27	9.29	0.34	25.49	6.53	27.73	0.03	1.05
Proline	5.11	0.17	1.41	17.52	14.33	8.83	14.08	11.28	2.23	0.18	3.69	12.58	2.42	0.11	0.01	0.60	5.47
Serine	4.39	9.82	2.57	10.05	7.14	0.54	23.17	0.02	17.00	0.06	0.29	20.90	0.12	0.54	1.52	0.58	1.27
Threonine	6.25	10.03	6.54	1.83	3.52	2.86	0.55	1.21	0.14	0.01	0.14	4.65	1.07	43.03	0.16	18.00	0.00
Tyrosine	7.57	4.67	7.80	0.00	3.32	1.44	0.79	0.20	0.02	22.65	14.72	0.04	14.01	16.57	3.57	0.07	2.54
Valine	9.48	1.30	0.20	0.10	17.82	0.75	0.03	0.46	2.43	0.44	3.57	4.68	6.39	2.65	33.99	5.01	10.71

Table 8: Feed land use and protein production

Feed source	**Land use(10^4 ha)**	**Protein(10^4t)**
Barley	29	13
Grass	140	47
Rape Meal	3	29
Wheat	6.4	5.8
Oats	20	0.5
Total	200	95

Land allocation and production values were obtained from Scottish Government [**scottish˙government˙statistics˙2017**].
Protein content was obtained from USFDA[ ].

Table 9: Plant-based food production in Scotland

Food Source	**Land Use (10^4 ha)**	**Protein(10^3 t)**
Potato	2.8	15
Barley	29	76
Wheat	11	100
Oats	3.1	0.85
Strawberries	0.1	0.19
Raspberries	0.3	0.03
Peas	0.4	0.44
Other Fruits		0.1
Carrots		1.9
Turnips	21	0.49
Brussels		0.4
Misc.Veg.		0.2
Total	67	200

Landuse data from Scottish Government [46].
Protein content from USFDA [47].

Table 10: Protein obtained from Scottish livestock. Efficiency (%) (protein conversion efficiency) was calculated using Feed Conversion Ratio and protein content data from FAO.

Sector	**Emission (10^4 t)**	**Efficiency %**
Beef	4.5	8.5
Milk	4.4	23.8
Lamb	1.5	9.8
Pork	1.8	20.2
Eggs	2.9	34.6
Chicken	3.2	34.9
Marine Fish	7.3	-
Farmed Fish	3.3	34.0
	Total:28.9	Avg:23.7

Table 11: CO_2 eq emission across sectors in Scotland

Sector	**Emission (10^6 t)**	**Contribution %**
Waste Management	1.4	3
Animal Emissions	5.7	11
Non-Animal Emissions	2.7	5
Business	8.2	16
Energy Supply	12	24
Exports	2.4	5
Industrial Process	0.43	1
Public Health	1.1	2
Residential	6.1	12
Transport	11	21

Supplementary Figures

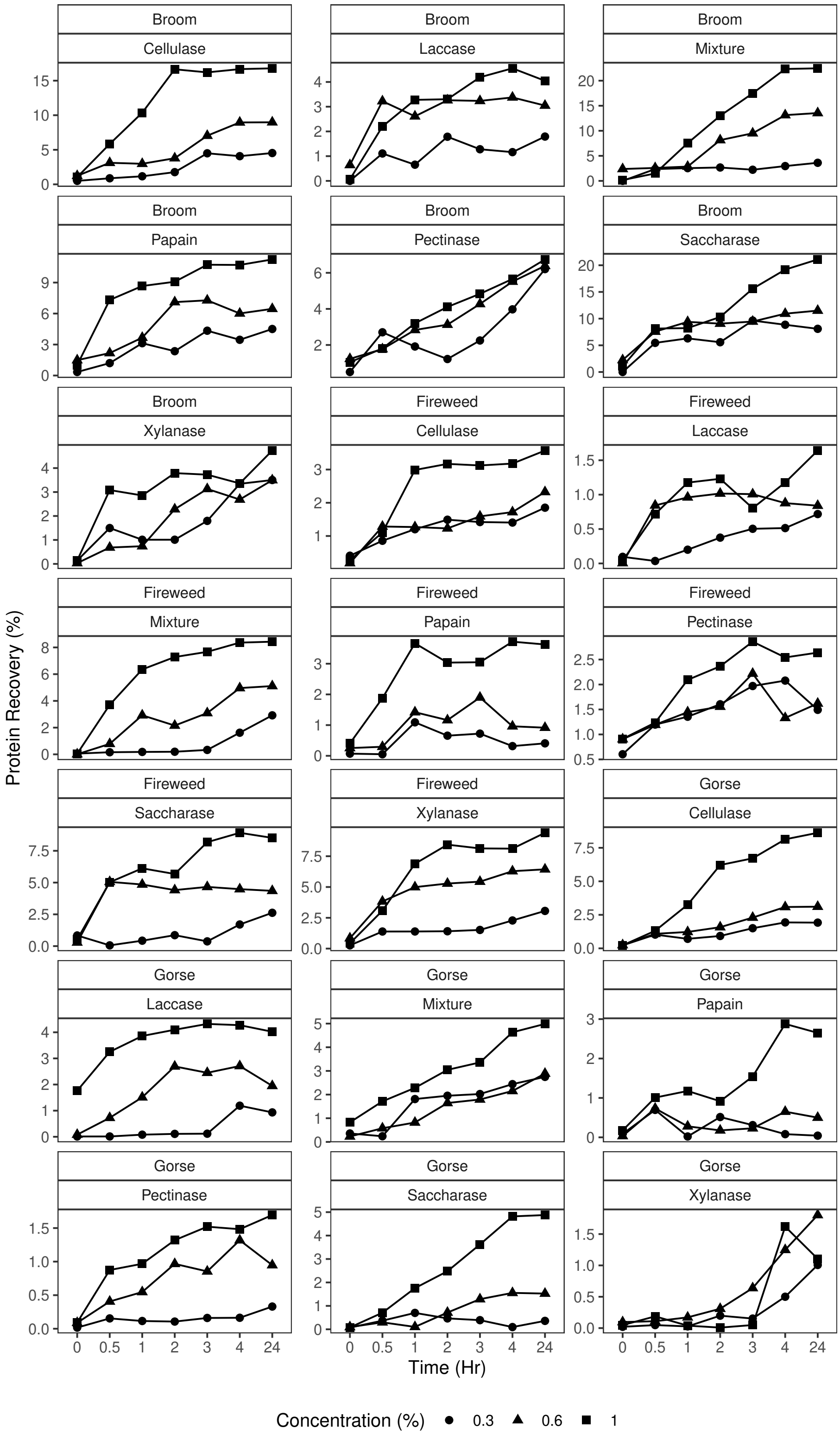

Figure 1: Protein recovery profile across different enzyme conditions

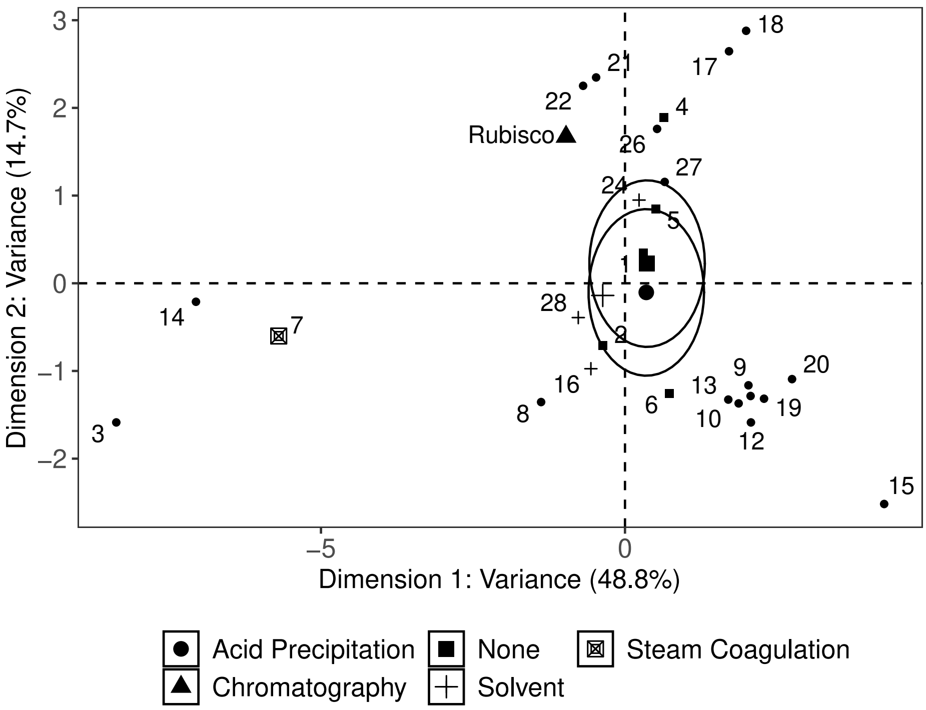

Figure 2: Univariate-scaled PCA plot of purity and amino acid profile of protein concentrates in previous literature marked according to Purification. The ellipse demarcates 95% confidence interval around group mean on plot area.

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