

Free amino acids of potato tubers: a survey of published results set out according to potato variety

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Summary

Ranges of contents of free amino acids (mg/100 g tuber dry matter) are tabulated for 13 varieties grown in 7 different countries. Publications reporting less-complete analyses are cited, and relate to approximately 45 further varieties.

Since the chemical composition of potatoes was reviewed by Burton (1966), the ion-exchange chromatographic procedures of Moore and Stein have come into general use for amino acid analysis, and have greatly improved its reliability, especially for free amino acids in the presence of other plant constituents. While Mr A. M. C. Davies was preparing for publication his work on free amino acids of potato tubers (Davies, 1977), we were surprised by the poverty of information about the varieties commonly grown in the British Isles. I accordingly undertook to review the published literature. This review is presented here and confirms our original impression.

The ion-exchange results (also one set obtained by gas-liquid chromatography (Hoff et al., 1971) are set out in Table 1. Most of the authors were studying effects of various treatments on a single variety of potato: only the ranges of values found are set out here. Table 1 does not include the specially important work of Talley et al. (1970), relating to the varieties Cobbler, Katahdin, Kennebec, Red Pontiac and Russet Burbank, which is discussed by Davies (1977). The detailed analyses of Red Pontiac by Kapoor et al. (1975) were received too late for inclusion in Table 1.

Publications giving results obtained by other methods, or for a few amino acids only, are cited in Table 2. Information relating to some further varieties is provided or cited by Chmulev & Bobryshev (1974), Desborough & Weiser (1974), Schwerdtfeger (1969) and Tavrovskaya (1964).

McDonald (1974) found pipercolic acid in tubers from plants infected with leaf-roll virus, but not in tubers from healthy plants. Werner et al. (1969) isolated *S*-methylmethionine in yields of 68-80 mg/kg tuber fresh weight (variety not stated).

Table 1. Free amino acids of potato tubers (mg amino acid/100 g tuber dry matter (range)).

Variety ¹	Bintje References ² Buri et al. (1970a, b)	Bintje Pion et al. (1971)	Benedetta Buri et al. (1970a)	Ostara Buri et al. (1970a, b)	Urgenta Buri et al. (1970a)	Superior Hoff et al. (1971)	Katahdin Fitzpatrick et al. (1964) Talley et al. (1964) Talley & Porter (1970)	Grata Coutrez- Geerincq (1970) Schaller (1974)
Locality of growth ³	Switzer- land	France	Switzerland	Switzerland	Switzerland	Indiana	Maine & New York	Belgium & W. Germany
Dry matter as % of fresh weight ⁴	25 (assumed) ⁷	20.8–24.6	25 (assumed)	25 (assumed)	25 (assumed)	21.3–22.4	18.0–23.8	–
N as % of dry matter ⁵	–	0.9–1.6	–	–	–	1.52–2.46	1.73–2.81	2.1–2.5,–
Non- protein N as % of total N ⁶	–	46.9–52.0	–	–	–	58–60	55–62	–
Aspartic acid		123–294	152	146	126		126–453***	167–302
Asparagine		660–1835	432	748	700	552–1010	1435–2625	1420–1948
Threonine		36	–	–	–	58–102	33–84	67–270
Serine		–	–	–	–	50–95	47–124	22–157
Glutamine		(169–197)	(131)	(310)	(130)	584–1507	–	974–1051
Glutamic acid		195–476	274	146	222		252–507	76–766
Proline		27–44	18	21	25	9–15	27–464	Tr–303
Glycine		6–19	5	10	9	16–23	9–27	17–22
Alanine		22–76	16	30	18	45–86	21–251	44–102
2-Aminobutyric acid		–	–	–	–	Tr	1–9*	–
Cystine		2–5	2	2	2	0	Tr	0
Valine		87–92	65	67	103	132–203	108–278	83–405
Methionine		26–87	14	25	40	42–64	46–127	13–128
Isoleucine		36–85	28	24	45	31–48	50–174	93–256
Leucine		22–38	18	12	23	22–47	30–86	45–137
Tyrosine		44–71	44	19	97	40–49	49–124	216–319
Phenylalanine		44–85	35	18	38	65–91	69–189	82–266
Tryptophan		10–12	5	4	13	1–21	1–41**	–
Lysine		24–229	16	22	37	41–90	49–169	70–274
Histidine		15–62	17	17	33	–	32–116	98–212
Arginine		66–306	42	76	125	116–268	125–465	122–444
4-Aminobutyric acid		151–>299	–	–	–	176–244	122–272	504
Remarks ⁸		Also ornithine				GLC analy- sis: traces of β-alanine and ornithine	Also β-ala- nine, ethanol- amine, ornithine, ammonia, methionine sulphoxides and sulphone	Also ethanol- amine and ornithine

* 'Unk. 3'; ** 'Unk. 4'; *** Figures in this column give ranges of groups – Zahlen in dieser Reihe geben den Bereich von Gruppenmittelwerten an – Les chiffres de cette colonne donnent les écarts des moyennes des groupes

† As asparagine (includes glutamine) – Als Asparagin (einschliesslich Glutamin) – Comme asparagine (y compris glutamine); †† Presumably – Wahrscheinlich – Vraisemblablement (Serine + Threonine).

FREE AMINO ACIDS OF POTATO TUBERS

Table 1. Continued.

Variety ¹	Ersteling (Duke of York)	Dansyaku	Russet Burbank (Netted Gem)	Red LaSoda	Kennebec	Maritta
References ²	Coutrez- Geerinck (1970)	Fujimaki et al. (1968)	Talley et al. (1958) Jaswal (1973)	Fitzpatrick et al. (1965)	Fitzpatrick & Porter (1966)	Schaller & Wünsch (1973)
Locality of growth ³	Belgium	Japan	Maine, New Brunswick ? New Jersey	Florida	Wisconsin	-
Dry matter as % of fresh weight ⁴	-	20.2-22.2	25 (assumed);-	17.9-18.0	18.0-20.5	-
N as % of dry matter ⁵	2.1-2.4	1.7-1.9	-	1.80-1.85	1.75-1.79	-
Non-protein N as % of total N ⁶	-	42.8-58.0	-	63-65	55-74	-
Aspartic acid	239-349	182-198	210-284	136-178	193-608	228
Asparagine	-	1462-2180†	-	1860-2460†	1935-2940†	-
Threonine	79-117	-	70-80	91-106	51-96	96
Serine	94-179	-	90-110	99-149	46-197	(760†)
Glutamine	-	With aspar- agine (above)	-	With aspar- agine (above)	With aspar- agine (above)	-
Glutamic acid	370-424	258-286	260-334	289-306	257-370	289
Proline	142-184	56-68	41-60	62-69	46-365	-
Glycine	13-20	12-18	10	36-39	13-52	6
Alanine	40-52	28-33	20-110	111-202	37-220	15
2-Aminobutyric acid	-	-	-	3-14	1-6	-
Cystine	0	0.5-1	9	-	-	-
Valine	239-322	186-203	128-350	310-320	198-316	24
Methionine	58-86	58-60	25-50	82-106	64-89	17
Isoleucine	98-155	67-90	40-80	144-154	82-166	17
Leucine	65-83	29-44	23-40	63-81	40-157	11
Tyrosine	219-264	185-210	73-170	201-242	124-344	35
Phenylalanine	144-208	105-141	75-130	155-205	103-200	48
Tryptophan	-	-	14	-	-	-
Lysine	197-223	50-98	77-180	185-193	116-312	17
Histidine	66-84	56-89	42-80	70-94	63-128	25
Arginine	281-359	98-189	200-320	332-490	303-493	81
4-Aminobutyric acid	-	-	150	309-410	170-325	61
Remarks ⁸	Also ammonia	Also ammonia	Also β-alanine, ammonia and several unknowns	Also β-alanine, ethanolamine, ammonia, ornithine, methionine sulphoxides and unknowns		

¹ Sorte - Variété; ² Literaturnachweis - Référence; ³ Herkunftsland - Lieu de culture; ⁴ Trockengewicht in % des Frischgewichtes - Matière sèche % du poids frais; ⁵ N in % der Trockensubstanz - N % du poids de matière fraîche; ⁶ Nichtweis. N in % des Gesamtstickstoffs - N non-protéique, % de N total; ⁷ Angenommen - Supposée; ⁸ Bemerkungen - Observations.

Tabelle 1. Freie Aminosäuren in Kartoffelknollen (mg Aminosäure pro 100 g Knollentrockensubstanz (Schwankungsbereich)).

Tableau 1. Teneur en acides aminés libres des tubercules de pommes de terre (mg d'acides aminés/100 g de matière sèche (écarts)).

Table 2. Free amino acids of potato tubers – less complete analyses.

Variety ¹	References ²
Agronomicheskii	Vecher & Reshetnikov (1966)
Aranyalma	Filep & Bukai (1969)
Bem	Mazur et al. (1974)
Bintje	Jaarma (1966, 1969); Amberger & Schaller (1973)
British Queen	McDonald (1974)
Buena Vista	Ordóñez & Russo (1966)
Charivnytsya	Vlasyuk et al. (1975)
Chippewa	Sweeney (1969)
Cinco Cerros	Ordóñez & Russo (1966)
Clivia	Amberger & Schaller (1973); Schaller & Amberger (1973)
Cosima	Amberger & Schaller (1973); Schaller & Amberger (1973)
Early Puritan	Jaarma (1966)
Epoka	Pojnar (1972); Mazur et al. (1974)
Fita	Mazur et al. (1974)
Flisak	Mazur et al. (1974)
Flora	Pojnar (1972); Mazur et al. (1974)
Grata	Amberger & Schaller (1973); Schaller & Amberger (1973)
Gülbaba	Filep & Bukai (1969)
Irish Cobbler	Sweeney & Simandle (1968); Sweeney (1969); Andreeva (1970)
Irmgard	Amberger & Schaller (1973); Schaller & Amberger (1973)
Kennebec	Sweeney (1969); Amberger & Schaller (1973)
King Edward	Jaarma (1966)
Lipen'skii	Vecher & Reshetnikov (1966)
Lori	Amberger & Schaller (1973); Schaller & Amberger (1973)
Loshitskii	Vecher & Reshetnikov (1966)
Magnum Bonum	Jaarma (1969)
Maritta	Amberger & Schaller (1973); Schaller & Amberger (1973)
Mittelfrühe	<i>Vid. sup.</i> (Bem)
Ona	Sweeney (1969)
Ostbote	Vecher & Reshetnikov (1966)
Paul Wagner	Andreeva (1970); Andreeva & Omel'chenko (1972)
Pontiac	Sweeney (1969)
Priekul'skii	Tavrovskaya & Pleshkov (1963)
Priekul'skii Rannii	Vecher & Reshetnikov (1966)
Pungo	Sweeney & Simandle (1968); Sweeney (1969)
Razvaristy	Vecher & Reshetnikov (1966)
Russet Burbank	Sweeney (1969); Kaldy (1971); Amberger & Schaller (1973)
Severnaya Roza	Tikhonov & Bychkov (1969)
Sirtema	Bancher et al. (1968)
Skorospelka II	Vecher & Reshetnikov (1966)
Tasso	Schaller & Amberger (1973)
Uran	Mazur et al. (1974)
Vol'tman	Andreeva (1970)
Voran	Vecher & Reshetnikov (1966)
White Rose	Trione & Almela Pons (1970)
Wild <i>Solanum</i> spp.	Piscitelli (1972)
Wyszoborski	Mazur et al. (1974)
Zazerskii	Vecher & Reshetnikov (1966)

¹ Sorte-Variété; ² Literaturnachweis-Référence.

Tabelle 2. Freie Aminosäuren in Kartoffelknollen – unvollständige Analysen.

Tableau 2. Acides aminés libres des tubercules de pommes de terre (analyses incomplètes).

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Zusammenfassung

Freie Aminosäuren in Kartoffelknollen: Zusammenfassung der publizierten Ergebnisse in Bezug auf die Kartoffelsorte

Tabelle 1 zeigt den Gehalt an freien Aminosäuren (mg/100 g Trockengewicht) von 13 Kartoffelsorten, die in 7 verschiedenen Ländern gewachsen sind. Veröffentlichungen mit unvoll-

ständigen Analyseergebnissen sind in Tabelle 2 aufgeführt und verweisen auf ungefähr 45 weitere Kartoffelsorten.

Résumé

Acides aminés libres des tubercules de pommes de terre – un aperçu des résultats publiés en fonction des variétés

Les écarts dans la teneur en acides aminés libres des tubercules (mg/100 g de matière sèche) sont répertoriés pour 13 variétés cultivées dans 7 régions différentes (tableau 1). Les publications

mentionnant les analyses sont citées et il est donné une liste des publications moins complètes concernant environ 45 autres variétés (tableau 2).

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