ACTA SOCIETATIS
BOTANICORUM POLONIAE
Vol. XLIII, nr 4
1974

Variety-specificity of soluble proteins of potato tubers

MARTA CZUPRYN and KAZIMIERZ TOCZKO

Institute of Biochemistry, Warsaw University, Poland
(Received: May 24, 1974)

Abstract

Separation of soluble tuber proteins from six potato clones and twelve varieties cultivated in Poland has been accomplished by disc electrophoresis. It was found that electrophoretic pattern was unique for a given clone or variety. Data obtained confirm results of the other authors for the other varieties and indicate that electrophoretic analysis of potato tuber proteins can be a useful method for taxonomic studies. Such analysis however cannot be used for genetic research since no correlations were found between electrophoretic patterns and genetic origin of respective clones and varieties.

INTRODUCTION

Soluble proteins having similar physico-chemical properties form the predominant fraction of potato tuber proteins (above 75%). For their characterization methods of paper electrophoresis (Morawiecka 1965; Zwartz 1966), agar gel (Zwartz 1966) and acrylamide gel electrophoresis (Loeschcke, Stegemann 1966; Desborough, Peloquin 1968, 1969 b) were employed. The last method is the most selective and of the greatest resolution capability.

Experiments performed with potato varieties cultivated in the United States showed that electrophoretic pattern was unique for a given variety (Desborough, Peloquin 1966, 1968, 1969 a; Wang, Peloquin 1969) and was not changed by ecological factors (Zacharius et al. 1971).

The purpose of this study was to establish if soluble tuber proteins of some potato clones and varieties most often grown in Poland were variety-specific and whether such a characterization could be useful for genetic and taxonomic studies.

MATERIAL AND METHODS

Material

Material was obtained from Institute for Potato Research, Research Unit Młochów. Tubers, 1972 collection, were stored at 4°. The experiments were carried out during four months (January-April 1973).

Table 1 gives the characterization of potato clones. The characterization of the investigated varieties as elaborated by Werner and Staszewicz (1972) is given in Table 2.

Table 1

Characterization of *Solanum stoloniferum* clones

No.	Clone	Crossing	Soluble protein[a] %
1	PG-194	(C.854 × Hochprozentige) × Hochprozentige	3.8
2	PG-211	[(C.854 × Hochprozentige) × Hochprozentige] × Hoch.	4.0
3	PG-212	(55957/24 × Hochprozentige) × Hochprozentige	3.0
4	69-III-72	(55957/24 × Hochprozentige) × Hochprozentige	4.0
5	PG-233	(55957/24 × USDA 96-56) × Ora	5.6
6	70-XVIII-98	{[(C.854 × 40182) × USDA 96-56] × USDA 96-56} × Merkur	3.5

[a]estimated by us by the biuret method (Layne 1957)

Table 2

Characterization of *Solanum tuberosum* varieties

No.	Variety	Cultivator[a]	Crossing	Registration year	Starch[b]	Soluble protein[c] %
1	Noteć	2	Flora × Orzeł	1970	7	2.2
2	Nysa	1	Flora × 16555	1968	8	3.1
3	Epoka	2	913 × Delfin	1955	5	1.7
4	Baca	1	Epoka × Polonia	1966	4	4.6
5	Lenino	2	Capella selection	1946	8	3.8
6	Uran	2	Lenino × Kołobrzeski	1960	7	2.0
7	Merkur	3	Industrie × Jubel	1935	5	1.8
8	Flisak	2	9 × Merkur	1951	5	2.5
9	Wyszoborski	2	(K.0.262 × Betula) × × BRA 13/31	1952	6	2.9
10	Warta	2	Wyszoborski × 1290	1963	6	3.5
11	Prosna	2	10465 × 951	1972	9	2.9
12	Wulkan	2	854/41 × 860	1958	7	2.7

[a]1—Institute for Potato Research, Poland
2—Institute for the Plant Breeding and Acclimatization, Poland
3—P. S. Uelzen, G F R
[b]4—12.6-14%; 5 — 14.1-15.5%; 6 — 15.6-17%; 7 — 17.1-18.5%; 8 — 18.6-20%; 9 — more than 20%
[c]estimated by us by the biuret method (Layne, 1957)

METHODS

Preparation of protein extracts

Protein extracts were prepared according to Desborough and Peloquin (1966) except that samples were not frozen at -25° prior to the electrophoretic run.

Electrophoretic separation of soluble tuber proteins

7.5% acrylamide gel was prepared according to Davis (1964). Only the small-pore gel was used. The electrophoretic separations were performed according to Desborough and Peloquin (1966). The gels were stained for about 4 hours with Amido Black 10B dissolved in water: methanol : acetic acid (6:3:1) and destained for 24 hours in 7% acetic acid. Electrophoretic analyses were performed several times for the same variety to assure the constancy and accuracy of band designation. Electrophoretic separation of tuber proteins of the variety Baca were done in addition to every separation procedure.

Special reagents

The special reagents used in this study were : acrylamide, N,N'-bismethylene acrylamide, ammonium persulfate from Serva (German Federal Republic), tetramethylethylenediamine (TEMED) from Kodak (United States), Amido Black 10B from Reachim (Soviet Union).

RESULTS AND DISCUSSION

The clones employed in this study are derivatives of *Solanum stoloniferum* and are genetically close. The pairs No. 1 and 2, 3 and 4 (Table 1) have even two common parents.

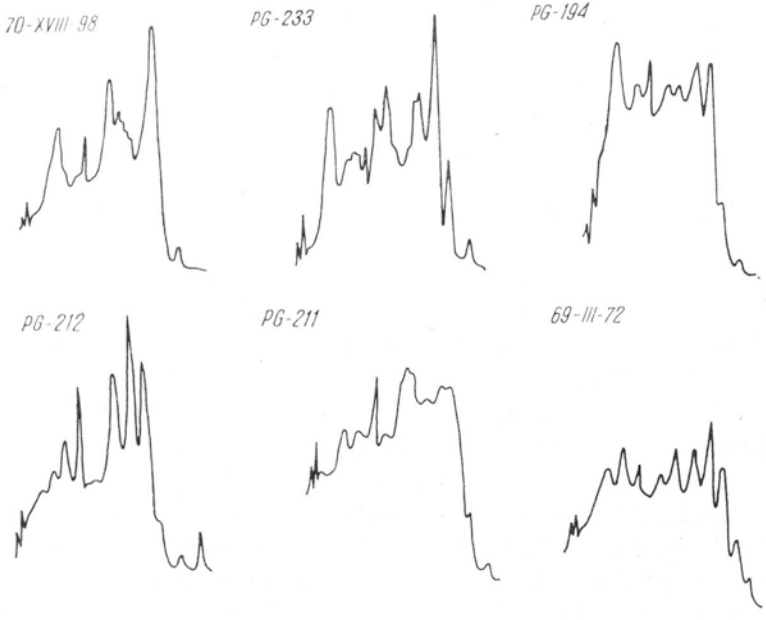

Fig. 1. Densitometer tracings of electrophoretic patterns of soluble tuber proteins from potato clones

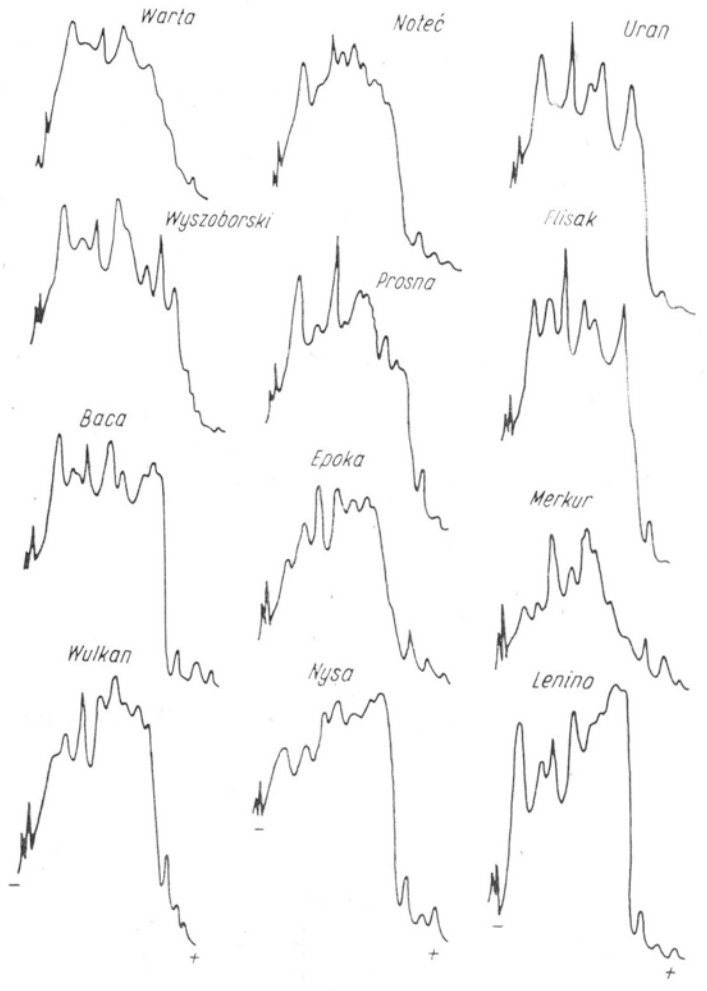

Fig. 2. Densitometer tracings of electrophoretic patterns of soluble tuber proteins from potato varieties

Examined varieties of *Solanum tuberosum* are late and medium late. Varieties No. 1, 2 and 3 (Table 2) derive from crossings descended from variety Stärkeragis. Moreover the pairs No. 3 and 4, 5 and 6, 7 and 8, 9 and 10 are genetically related. No. 11 and 12 do not show genetic relation to the varieties mentioned above.

Fig. 1 shows densitometer tracings of electrophoretic patterns of soluble proteins from potato clones and Fig. 2 from potato varieties. Diagrammatic representation of protein electropherograms of the examined clones and varieties are presented in Fig. 3 and Fig. 4 respectively. Two bands near the start observed in the all cases (probably aggregates) were not considered. It appears from the comparison of the electropherograms that electrophoretic pattern is unique for a given clone or variety. Moreover the patterns are different from the patterns of some american varieties obtained by the same method (Desborough, Peloquin 1966, 1968). Thus on the

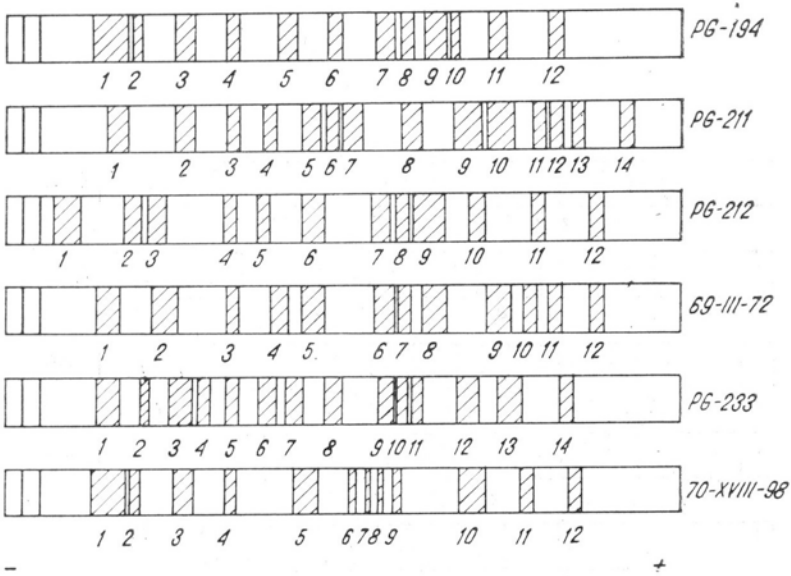

Fig. 3. Diagrammatic representation of electropherograms of soluble tuber proteins from potato clones

basis of the position and number of bands it is possible to identify a given variety; therefore the applied method can be used for taxonomic studies.

The comparison of the bands position on the electropherograms reveals that some varieties have fractions of the same electrophoretic mobility. The clones produce more bands of the same electrophoretic mobility (up to 7 bands) than the varieties do.

A number of protein bands of the same electrophoretic mobility for particular pairs is given in Table 3 (clones) and Table 4 (varieties). It is evident from these results that there is no close correlation between genetic origin and a number of common bands. This is stronger marked for the varieties than for the clones. Non-related varieties Prosna and Nysa have no common bands, whereas also non-related Prosna and Wyszoborski have 6 common bands. Related varieties Uran and Lenino have 2 common bands, whereas related Warta and Wyszoborski have 4 bands of the same electrophoretic mobility. Data obtained do not confirm suggestions of Desborough and Peloquin (1966) that the disc electrophoresis of soluble tuber proteins can be a suitable method for genetic purposes.

This work was partly supported by the Ministry of Agriculture within the project 09.1.2.

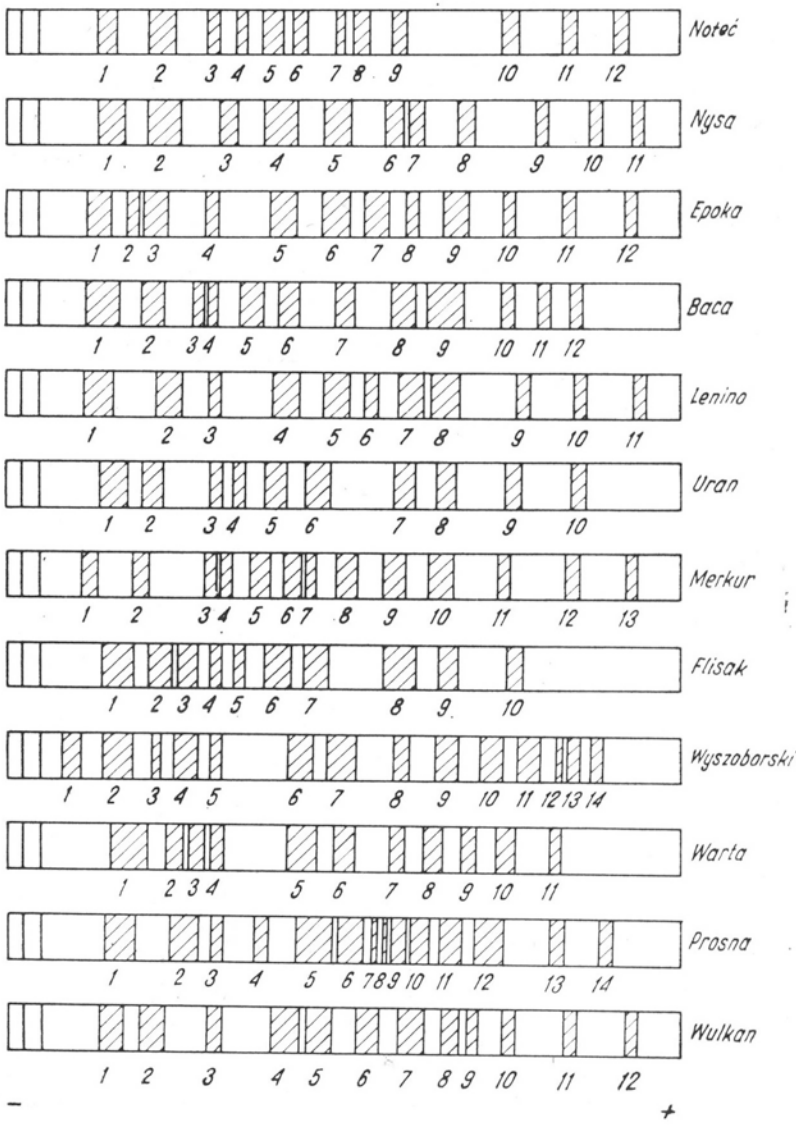

Fig. 4. Diagrammatic representation of electropherograms of soluble tuber proteins from potato varieties

Table 3

Protein bands of the same electrophoretic mobility for the particular pairs of clones

	PG-194	PG-211	PG-212	69-III-72	PG-233	70-XVIII-98
PG-194	12	6	5	7	4	4
PG-211		14	4	5	6	5
PG-212			12	7	2	2
69-III-72				12	2	3
PG-233					14	4
70-XVIII-98						12

Table 4

Protein bands of the same electrophoretic mobility for the particular pairs of varieties

	Noteć	Nysa	Epoka	Baca	Lenino	Uran	Merkur	Flisak	Wyszoborski	Warta	Prosna	Wulkan
Noteć	12	2	2	2	3	3	3	3	3	1	1	3
Nysa		11	2	1	5	0	1	0	0	0	0	3
Epoka			12	3	4	1	3	1	1	1	1	5
Baca				12	2	3	3	2	4	3	2	3
Lenino					11	2	1	2	2	1	1	5
Uran						10	1	6	1	1	1	4
Merkur							13	1	3	2	2	3
Flisak								10	3	1	3	3
Wyszoborski									14	4	6	1
Warta										11	4	2
Prosna											14	1
Wulkan												12

REFERENCES

Davis B. J., 1964. Disc electrophoresis — II. Method and application to human serum proteins, Ann. N. Y. Acad. Sci. 121: 404—427.

Desborough S., Peloquin S. J., 1966. Disc electrophoresis of tuber proteins from *Solanum species* and interspecific hybrids, Phytochem. 5: 727—733.

Desborough S. and Peloquin S. J., 1968. Potato variety identification by use of electrophoretic patterns of tuber proteins and enzymes. Amer. Potato J. 45: 220—229.

Desborough S. and Peloquin S. J., 1969 a. Acid gel disc electrophoresis of tuber proteins from *Solanum species*, Phytochem. 8: 425—429.

Desborough S. and Peloquin S. J., 1969 b. Tuber proteins from haploids, selfs and cultivars of group *Tuberosum* separated by acid gel disc electrophoresis, Theoretic. Appl. Genet. 39: 43—47.

Layne E., 1957, Spectrophotometric and turbidimetric methods for measuring proteins in Methods in Enzymology, ed. L. Grossman, K. Moldave, Acad. Press, London, N. Y., vol. 3, p. 450—451.

Loeschcke V. and Stegemann N., 1966. Proteine der Kartoffel-Knollen in Abhängigkeit von Sorte und Virosen (Polyacrylamid-Electrophorese), Phytochem. 5: 985—991.

Morawiecka B., 1965. Białka ziemniaka (*Solanum tuberosum*) rozpuszczalne w kwasie sulfosalicylowym, Acta Soc. Bot. Pol. 2: 161—171.

Wang H. and Peloquin S. J., 1969. Cytogenetic and acid-gel electrophoretic analysis of species relations among Argentine diploid Solanums, Amer. Potato J. 46:439.

Werner E. and Staszewicz K., 1972. Odmiany uprawne ziemniaka w kolekcji Instytutu Ziemniaka w Boninie, Biul. Inst. Ziem. 9: 5—11.

Zacharius R. M., Krulick S. and Porter W. L., 1971. Concerning the constancy of the protein electrophoretic pattern of potato tuber variety, Amer. Potato J. 48: 57—63.

Zwartz J., 1966. Potato varieties and their protein electropherogram characteristics, Europ. Potato J. 9:111—128.

Author's address:
Doc. dr. Kazimierz Toczko
Mgr. Marta Czupryn
Instytut Biochemii U. W.
ul. Żwirki i Wigury 93,
02-089 Warszawa. Poland

Specyficzność odmianowa rozpuszczalnych białek bulw ziemniaka

Streszczenie

Przeprowadzono elektroforetyczną charakterystykę rozpuszczalnych białek bulw 6 rodów hodowlanych i 12 odmian ziemniaków uprawianych w Polsce. Stwierdzono, że obraz elektroforetyczny jest charakterystyczny dla danego rodu czy odmiany, a tym samym potwierdzono wyniki innych autorów uzyskane dla innych odmian. Nie znaleziono natomiast korelacji między pokrewieństwem genetycznym a liczbą frakcji o tej samej ruchliwości elektroforetycznej. Stosowana metoda może więc być wykorzystana do celów taksonomicznych, natomiast nie nadaje się do analizy pokrewieństwa genetycznego.