SPECIFIC ROTATION OF CEREAL AND LEGUME STARCHES[1]

R. D. PATEL, R. P. PATEL, AND R. S. PATEL

ABSTRACT

Defatting starch with 85% methanol decreased the protein content considerably. The average specific rotation values for sixteen defatted cereal and legume starches were 203° and 202° respectively. The extreme range of specific rotation values, calculated on the basis of true starch content determined by difference and by enzyme-acid hydrolysis, was 201°–204°. Genetic factors and growth conditions have thus little influence on this property of starch.

This investigation was undertaken with the purpose of assessing the improved calcium chloride polarimetric procedure (2,3) as a means of determining starch in cereal and legume starch products. Specific rotation values for sixteen different cereal and legume starch samples of high purity have been determined under the conditions of this method.

Materials and Methods

The grains were soaked in a 0.3% sulfur dioxide solution and crushed to pulps. The starches were isolated from the pulps by the procedure of Clendenning and Wright using 0.25*N* sodium hydroxide solution instead of 0.25*N* ammonium hydroxide solution to render the proteins more soluble. The starches were then extensively extracted by five 2-hour digestions with 85% methanol (5) under reflux. They were filtered and washed with 85% methanol between each extraction and were finally extracted for 8 hours with 85% methanol in a Soxhlet. (This treatment eliminates the fats and reduces the protein.) The starches were dried in the sun, ground, and passed through an 80-mesh sieve.

The moisture contents of the samples were determined by drying to constancy *in vacuo* (10–15 mm. of mercury) at 105°C.; ash by ignition at 575°C.; and protein by Kjeldahl procedure (1). A protein conversion factor of 5.7 was employed in calculating the protein content of wheat starch, 6.25 being used for all others.

The true starch content of all the samples was determined by subtracting the measured content of moisture, ash, and protein from 100 (Table I, column A) and also by the diastase-hydrochloric acid meth-

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od (1). A dextrose-starch conversion factor of 0.93 was used with all the starches.

The starch solutions were prepared for polarimetry by the method of Clendenning and Wright (3). Ten milliliters of 5% uranyl acetate were included as protein precipitant (2). The filtrate was polarized in a 20-cm. tube, using sodium light. Defatted starches provide clearer solutions and the polarimetric field is more sharply defined than with nondefatted starches.

Results and Discussion

Sixteen specific rotation values for cereal starches range only from 202.2° to 204°, averaging 203° (Table I). Observations on cereal starches in India agree closely with those of Earle and Milner (4) in

TABLE I

SPECIFIC ROTATION OF DEFATTED CEREAL AND LEGUME STARCHES

STARCH SOURCE: GENUS AND SPECIES, AND ENGLISH EQUIVALENT	MOISTURE	ASH	PROTEIN	SPECIFIC ROTATION	
				A	B
	%	%	%	*degrees*	*degrees*
CEREALS					
Eleusine coracana Gaerth. (Raggee millet)	7.80	0.03	0.33	203.0	203.4
Paspalum scrobiculatum L. (India pappusgrass)	7.80	0.03	0.39	202.6	202.8
Triticum sativum Law. (wheat)	7.70	0.07	0.35	202.7	203.3
Oryza sativum L. (rice)	7.50	0.05	0.33	202.2	204.0
Andropogon sorghum Brot. (sorghum vulgare)	7.50	0.08	0.29	203.1	203.5
Pennisetum typhoideum Rich. (pearl millet)	7.65	0.05	0.40	202.5	203.1
Panicum miliare Lamk. (little millet)	7.60	0.07	0.35	202.8	202.2
Panicum miliaceum L. (broomcorn millet)	7.60	0.05	0.39	202.8	203.2
LEGUMES					
Lathyrus sativus L. (grass peavine)	8.48	0.06	0.30	201.9	202.2
Dolichos lablab L. (hyacinth bean)	8.02	0.08	0.25	201.8	203.0
Cajanus indicus Spreng. (pigeon pea)	9.90	0.04	0.21	202.4	203.0
Phaseolus mungo L. (urd bean)	12.00	0.06	0.15	201.4	201.8
Cicer arietinum L. (gram chick pea)	12.30	0.03	0.27	201.0	201.0
Phaseolus aconitifolius Jacq. (moth bean)	10.10	0.08	0.30	201.6	202.8
Vigna catjang Endl. (Catjang cowpea)	10.80	0.06	0.30	202.3	203.0
Pisum sativum L. (garden pea)	11.40	0.02	0.30	202.2	203.0

the United States and with those of Clendenning and Wright (3) in Canada. For this reason it is concluded that the specific rotatory power of cereal starches is not influenced significantly either genetically or by the particular environment under which the starch is synthesized.

Sixteen specific rotation values for legume starches (Table I) have slightly lower average than for cereal starches (202° instead of 203°). Legume starch values are appreciably higher than the values for legume starches reported by Clendenning and Wright (3). These small differences may have resulted from different contents of impurities or inaccuracies in their estimation. Since average specific rotation values for legume and cereal starches agreed within 0.5%, it appears likely that the specific rotatory power of starches from cereals and legumes is actually the same.

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