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CHEMICAL COMPOSITION OF THE SELECTED VARIETIES AND STRAINS OF OAT

Abstract

Apart from many factors, quality of both plant and animal raw materials plays a crucial role in quality of food products as early as the beginning of the manufacturing process. It is clearly visible in plant raw materials in which quality at least at a certain stage can not be controlled by man. A sudden change in weather conditions can cause a big difference in technological parameters of the same variety of corn grown in different regions of the country during the harvest time. The criteria of purchase of the already mentioned corns are very simple and in case of oat very limited. It concerns some parameters pertaining to the science of commodities and that is all. Yet a grain does not only consist of shape, mass, density and colour. It mainly contains protein, starch, fat, cellulose and recently very popular β-glucans.

Mixing corns of different varieties, or the same variety, but of different parameters contributes to an average value of chemical properties, and consequently to obtaining commercial oat of general (poor) quality. A high health quality of oat due to its specific chemical composition should make technologists point out which varieties are to be used to either manufacture diet products, or fodder.

Aim of the work

The subject of this work is an analysis of chemical composition (protein, fat, starch, reducing sugars, β-glucans, cellulose and ash) of nineteen varieties and strains of oat coming from breeding work carried out at four stations in Choryń, Polanowice, Strzelce, Wielopole in 1999. Besides, it is important to stress the differences in certain values among the samples.

Experimental part

Research material and methodology

The research material of this work were bruised grains of the following varieties and strains of oats: Akt, Bajka, Cekin, CHD 1396, CHD 1441, CHD 1598, CHD 1698,

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Chwat, Dragon, Dukat, Grajcar, Hetman, Jawor, Kasztan, Komes, Sam, Sławko, Skrzat, Szakal. The samples of the above-mentioned varieties and strains came from four stations of cultivation in Choryń, Wielopole, Strzelce, Polanowice. Before proceeding to the research work they were sifted through the sieves of 0,43 mm and ground in the laboratory grinder WŻ-1. The well sifted and mixed bruised grains were a research material.

In this work the following analyses were carried out:

- marking of dry substance according to Jermakow [10],
- marking of the content of protein according to Kjeldahl's method [4],
- marking of the content of fat [4],
- marking of the content of starch according to Clendenning [9],
- marking of the content of reducing sugars according Luffa-Schoorl's method [11],
- marking of the content of β-glucans according to ICC methods [2],
- marking of the content of cellulose according to AOAC methods [1],
- marking of the content of ash [15].

Results of reseach and discussion

The results of the conducted analyses have been put together in Table 1, which presents the chemical composition (protein, fat, reducing sugars, ash, β-glucans cellulose) of the nineteen varieties and strains of oats.

By evaluating the content of protein in each sample it is clearly visible that Komes is characterized by the maximum amount of protein (16, 49%) and Bajka is the minimum (11,41%) (Chart 1). Seven varieties and strains above the average (13,79%).

The obtained average content of protein – 13,8% is consistent with the data in professional literature. [6, 16], and does not differ from the world average, hovewer there are varieties in which the content of protein ranges from 20 to 23%, but they are grown for specific purpose (for instance, fodder).

The strain of CHD 1441 is characterized by the highest percentage of protein (15,45%) among the studied strains. The content of fat ranges from 10.56% (Kasztan) to 6,26% (Szakal) at the average of 8.07 for all the sample (Chart 2).

The marked content of fat (6,26% – 10,56%) is confirmed by the data in the works of Brown and Craddock [3, 6], who report that the content in defatted grain of oat ranges from 3% to 11,6%.

Kasztan grown in Polanowice is the variety with the highest content of fat as was marked during many years' research at the Department of Techonology of Carbohydrates of the Academy of Agriculture in Cracow. Other high-fat varieties are: Grajcar (9.35%) bred in Wielopole, Dragon (9,18%) bred in Choryń. A high content of fat is also characteristic for Akt, an unweeded variety, which contains 9.75% of fat. The

percentage of fat of the researched strains of oat belongs to the group of the lowest values (CHD 1698-7.00%; CDH 1598-7.06%; CHD 1441-7.06%).

Table 1

Chemical composition of nineteen varieties and strains of oats.

Oats	Station	s.m. [%]	Protein [%]	Fat [%]	Starch [%]	Red.sugar [%]	Ash [%]	β-glucan [%]	Cellulose [%]
Jawor	Choryń	90,19	11,79	7,74	49,80	0,40	1,91	3,70	14,33
Hetman	Choryń	90,07	16,27	8,18	52,69	0,42	2,12	4,06	15,65
Dragon	Choryń	90,00	13,71	9,18	47,99	0,39	2,07	3,68	16,71
Komes	Choryń	90,11	**16,49**	8,98	**43,64**	0,38	1,95	4,46	16,52
CHD 1598	Choryń	89,84	13,58	7,06	52,40	0,42	2,03	4,34	15,92
CHD 1698	Choryń	89,81	12,93	7,00	**58,98**	0,41	1,99	5,00	14,23
CHD 1441	Choryń	89,65	15,45	7,06	47,18	**0,52**	2,02	4,17	15,21
CHD 1396	Choryń	89,69	12,49	7,83	56,11	**0,31**	**1,78**	3,56	**12,71**
Cekin	Wielopole	90,13	13,39	8,42	52,64	0,32	1,91	**3,07**	14,03
Grajcar	Wielopole	**89,43**	13,91	9,35	50,41	0,36	1,82	3,54	13,95
Dukat	Wielopole	90,26	14,82	7,48	50,73	0,32	1,95	3,23	16,16
Akt	Strzelce	90,17	14,82	9,75	49,87	0,51	**2,42**	4,26	**17,25**
Bajka	Strzelce	90,04	**11,41**	7,46	51,86	0,47	2,02	4,56	16,62
Sam	Strzelce	89,96	12,73	7,21	54,38	0,52	2,00	4,47	15,70
Szakal	Strzelce	89,77	15,99	**6,26**	55,53	0,34	2,12	4,48	15,78
Chwat	Strzelce	90,01	14,48	7,39	53,36	0,51	1,96	**5,05**	15,86
Sławko	Strzelce	90,15	11,56	7,74	51,10	0,41	1,80	3,89	14,93
Kasztan	Polanowice	**90,49**	12,13	**10,56**	46,49	0,37	2,00	4,14	17,15
Skrzat	Polanowice	90,12	14,10	8,73	53,44	0,39	1,90	4,54	14,93

Sources: own research

Chart 1 Content of Protein %

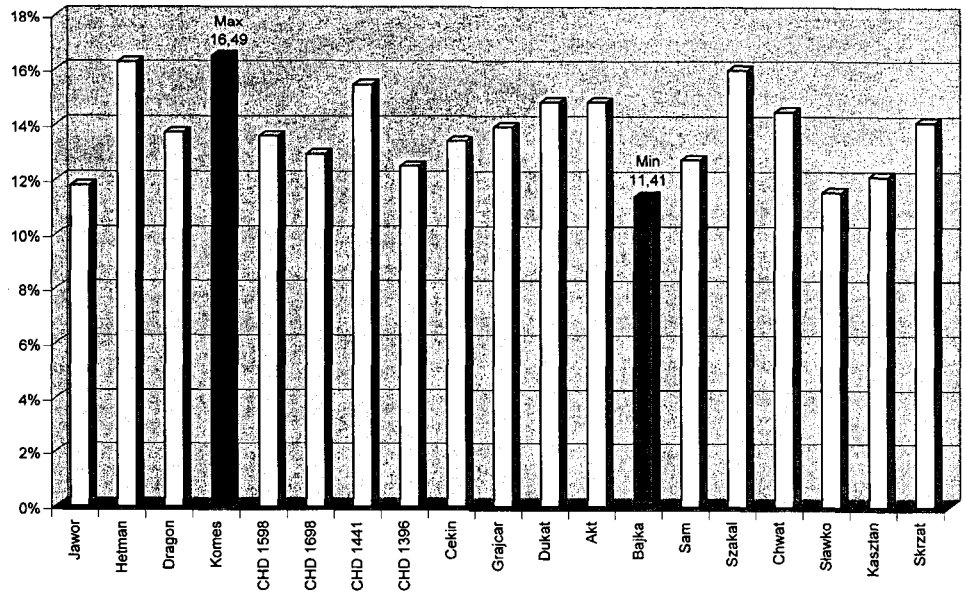
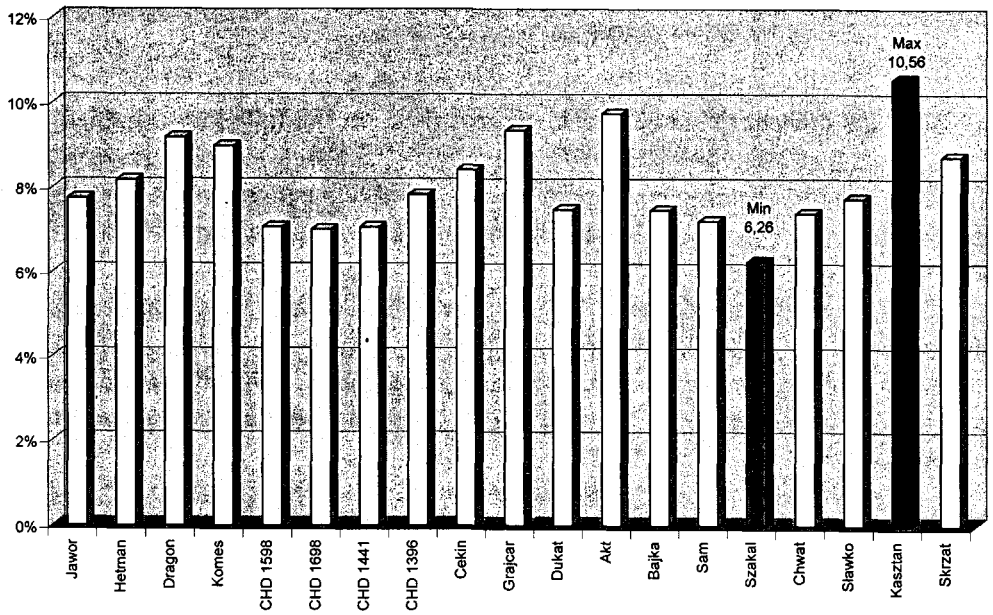
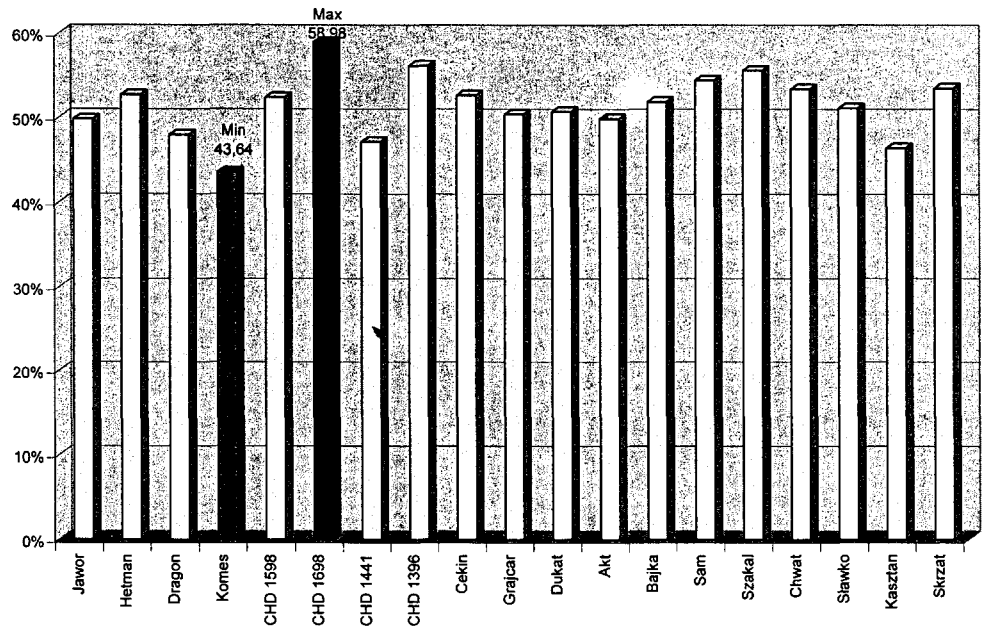


Chart 2 - Content of Fat %



While analyzing the amount of starch in the individual varieties, one can conclude that this value ranges from 58.98% (CHD 1698) to 43.63% (Komes). There are 10 samples above this value.

Chart 3 - Content of Starch (%)



The high content of starch is also characteristic for the following varieties: CHD 1396 (56.11%), CHD 1598 (52.40%) and Szakal (55.53%). Apart from Komes the following varieties belong to those containing a small amount of starch: Kasztan (46.49%), Dragon (47.99%). Among the strains CHD contains the lowest amount of starch (47.18%).

The marked average content of starch is not much different from the data in professional literature [6, 8, 13, 17], reporting that the content of starch in oat is 55%.

The samples of the varieties form Strzelce used for the analysis are characterized by a high content of starch. The average for the samples from this station has the highest value of 52.68%.

The content of reducing sugars ranges from 0.52% (CHD 1441) to 0.31% (CHD 1396). The average for all the measurements equals 0.41%. The difference in value results from a various state of maturity of corns during the harvest time [17].

The value of ash ranges from 2.42% (Akt) to 1.78% (CHD 1441) to 0.31% (CHD 1396) at the average value of 1.99%. The marked values of ash are similar to the data

from professional literature, in which the content of ash ranges from 1.65% to 2.00% [8]. Only the amount of ash for an unweeded sort of oat (Akt) exceeds this limit. The factors such as climatic and soil conditions, the year of harvest and fertilizing have an impact on the level of mineral components. Taking mechanization of harvest of oat, preparation of uniform mixtures for processing and a standarized way of processing in the factory into account, one can accept that a natural changeability in content of the basic components is not big and has no practical significance in men's feeding [6].

The varieties from Strzelce and Polanowice are characterized by a high content of β- glucans. The average values for these stations are 4.45% and 4.34% while the average for all the stations equals 4.12% for the range from 5.05% (Chwat) to 3.07% (Cekin). The marked values are consistent with the data from professional literature. It is generally accepted that the content of β-glucans varies from 3 to 7% [16].

In domestic oats the average value for many years is 4.6% [7]. Some authors [5, 17] think that the content of β-glucans is a characteristics for a given variety also depending on environment.

The amount of food cellulose varies from 17.25% (Akt) to 12.71% (CHD 1396) at an average value of 15.45%. The marked content of cellulose is confirmed by the data from professional literature [12, 13], which report that this value ranges from 10.7% to 19.4%.

Statistical interpretation

In order to emphasize the crucial correlations the obtained results of the chemical composition were subjected to a statistical analysis. With this end in view the importance of correlation coefficients was being verified by means of the test of essentiality using t-Student's statistics [18]. The obtained results are presented in Table 2.

Taking the data from Table 2 into consideration, one can conclude that there are directly and inversely proportional correlations of different strength. The most important correlations are in bold. There is no crucial correlation between protein and other components. The directly proportional are the folllowing components – ash and cellulose ($r = 0{,}6802$; $p = 0{,}001$), sugars and β-glucans ($r = 0.5997$; $p = 0.007$), sugars and ash ($r = 0.4606$; $p = 0.047$). The inversely proportional correlation is indeed between fat and starch ($r = -07127$; $p = 0{,}001$). The other correlations can not be considered as statistically important (a high or very high probability of no occuring a given correlation).

Table 2

Correlation coefficients for the analysed samples.

	Sugars	Fat	Ash	Starch	β-glucan	Cellulose
Protein	0,0221 p = 0,929	-0,0555 p = 0,821	0,4128 p = 0,079	0,012 p=0,961	0,1175 p = 0,632	0,4337 p = 0,064
Sugars		-0,1857 p = 0,447	0,4606 p = 0,047	0,0361 p=0,883	0,5997 p = 0,007	0,4707 p = 0,042
Fat			0,1354 p = 0,580	-0,7127 p = 0,001	-0,3109 p = 0,195	-0,0637 p = 0,795
Ash					0,303 p = 0,207	0,6802 p = 0,001
Starch					0,3543 p = 0,137	-0,2823 p = 0,242
β-glucan						0,3141 p = 0,190

Conclusions

1. Basing on the carried out analyses of the nineteen varieties and strains of oats one can affirm a high content of protein, fat and β-glucans, which decidedly inhances physiological and nutritious values of oats .
2. In the course of the past ten years we have been observing a significant rise in the content of protein, fat and starch in the grain of oats.
3. Taking the high nutritious values of oats fat and at the same time a big content of total fat (Kasztan) into consideration one can be tempted to isolate it on a industrial scale.
4. The varieties with a high rate of the content of cellulose and at the same time with a big number of β-glucans (Bajka, Chwat, Komes) can be used to produce cellulose preparations.
5. The unweeded variety of Akt due to its chemical composition is characterized by high rates of the content of protein, fat, starch, ash, β-glucans and cellulose can be a valuable raw material for producing diet food.
6. Taking a high biological value and a favourable composition of amino acids of oats protein and its big amount (Komes, Hetman) an attempt can be made to isolate protein from the oats on a commercial scale, or to use these varieties for fodder.
7. Basing on the carried out statistical analysis no inverse correlation between protein and starch has been confirmed, but one can notice positive correlations between ash and cellulose, sugars and β-glucans, sugars and cellulose, sugars and ash.

LITERATURE

[1] AOAC Standard nr. 985.29.
[2] Bhatty R.S.: Extraction and Enrichment of (1-3), (1-4)-beta-D-Glucan from Barley and Oat Bran, Cereal Chemistry, **70**, 1993, 73.
[3] Brown C.M., Craddock V.P., Mckenzier R.I.M.: Crop. Soi., **17**, 1977, 145.
[4] Fortuna T., Gibiński M., Nowotna A.: Ćwiczenia z analizy żywności, Kraków 1992, 99.
[5] Hensel W.: Polska starożytna, Ossolineum, Wrocław 1980.
[6] Gąsiorowski H.: Owies-chemia i technologia, PWRiL, Poznań 1995.
[7] Gąsiorowski H., Klockiewicz-Kamińska A., Górecka D.: Charakterystyka polskiego owsa (cz. 2), Technologiczne wskaźniki jakości polskiego owsa, Przegląd Zbożowo-Młynarski, **4**, 1997, 23.
[8] Gąsiorowski H., Urbanowicz M.: Owies - roślina XXI wieku (cz. III), Tłuszcze i węglowodany, Przegląd Zbożowo-Młynarski, **36**, 1992, 2.
[9] ICC Standard Nr. 122.
[10] Jermakov A.J., Smirnows M.: Metody biochimicznieskowo isliedowanija rastienij, Sielsko, Moskva 1952.
[11] Kirh R.S., Sawyer R.: Person's Composition and Analysis of Foods, Longman 1991.
[12] Luhaloo M., Martensson A.C., Andersson R., Aman P.: Compositional analysis and viscosity measurements of commercial oat brans, Journal of the Science of Food and Agriculture, **76**, 1998, 142.
[13] Matz S.A.: Oat in cereal, Science AV i Pub., Co Westport CE, 1969.
[14] Paton D.: Oat starch, Extraction, Purifaction and Pasting Properties, Staerke, **29**, 1977, 149.
[15] PN-68/A-74014, Oznaczenie zawartości popiołu ogólnego w ziarnie zbóż i produktach zbożowych.
[16] Pomeranz Y.: Advances in cereal science and Technology, Vol.5, st. Paul, 1987.
[17] Wood P.J.: Aspect of the chemistry and nutritional effects of non-starch polysaccharides of cereal, Developments in Carbohydrate Chemistry, Alexander R.I., Zobel H.Z., St. Paul, MN: Amer. Assoc. Cereal Chem, 293.
[18] Zając K.: Zarys metod statystycznych, PWE, Warszawa, 1994.

SKŁAD CHEMICZNY WYBRANYCH ODMIAN I RODÓW OWSA

Streszczenie

Skład chemiczny owsa, zarówno pod względem ilościowym jak i jakościowym, decyduje o dużej przydatności tego zboża w żywieniu człowieka. Zawartość składników odżywczych w owsie w znacznym stopniu różni się od zawartości w pozostałych zbożach.

W niniejszej pracy przeprowadzono analizę składu chemicznego dziewiętnastu odmian i rodów owsa. Na podstawie otrzymanych wyników stwierdzono, iż niektóre odmiany mogą być cennym surowcem do produkcji żywności. Oznaczone wysokie zawartości białka, tłuszczu, skrobi, błonnika dla niektórych odmian i rodów owsa takich jak: Hetman, Akt, Chwat, Skrzat, mogą decydować o przydatności w przemyśle produkującym środki dietetyczne. Wysoka zawartość błonnika w przypadku: Aktu, Kasztana, Bajki, Komesa, Szakala, CHD 1598, Sama, mogą kwalifikować te odmiany i rody do produkcji preparatów błonnikowych. W przypadku Kasztana uzyskano najwyższy wskaźnik zawartości tłuszczu.