



COMPETITIVENESS OF THE POLISH DAIRY INDUSTRY IN THE EU MARKET

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Abstract

The structural transformations occurring in the Polish dairy industry, to a large extent, arise from the processes of its adaptation to the uniform EU market conditions. The thorough modernization of milk production and processing technologies has enabled the producers to achieve a considerable improvement of the quality of dairy products, which alongside the cost and price advantage of Polish dairy producers is an important contributor to the competitiveness in the EU market. The purpose of this study has been to make an assessment of the prospects for further growth in the competitiveness of the Polish dairy industry in international markets. The dairy industry in Poland was compared to selected EU countries with regards to the quality of raw material supplies, the worth and structure of the production of dairy products, labour efficiency, and production concentration. The study showed that any further growth in the export of Polish dairy products will require more intensive promotional campaigns, so that European consumers would be able to identify Poland with a greater array of dairy products.

KONKURENCYJNOŚĆ POLSKIEGO PRZEMYSŁU MLECZARSKIEGO NA RYNKU UE

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Słowa kluczowe: konkurencyjność, przemysł mleczarski.

Abstrakt

Przemiany strukturalne zachodzące w polskim przemyśle mleczarskim w dużej mierze są efektem procesów dostosowawczych do funkcjonowania w ramach jednolitego rynku Unii Europejskiej. Gruntowna modernizacja procesów produkcji mleka i jego przetwórstwa umożliwiła znaczną poprawę jakości produktów mleczarskich, która w połączeniu z przewagą kosztowo-cenową stała się ważnym czynnikiem konkurencyjności na unijnym rynku. Celem artykułu była ocena perspektyw dalszego wzrostu konkurencyjności polskiego przemysłu mleczarskiego na rynkach międzynarodowych. Przemysł mleczarski w Polsce skonfrontowano z wybranymi krajami UE pod względem jakości bazy surowcowej, wartości i struktury produkcji sprzedanej wyrobów mleczarskich, wydajności pracy oraz koncentracji produkcji. W wyniku badania udowodniono, że rozwój polskiego eksportu produktów mleczarskich będzie możliwy w wyniku intensyfikacji działań promocyjnych w taki sposób, aby konsumenci europejscy kojarzyli z Polską coraz większą liczbę tych wyrobów.

Methods and materials

The purpose of this study has been to make an assessment of the prospects for the further growth of competitiveness in the Polish dairy industry in international markets, especially in the EU. To this aim, the current position of the Polish dairy industry was evaluated against the background of the selected EU member states: Germany, France, the UK, Italy, Belgium, the Netherlands, Slovakia, Hungary and Lithuania. The dairy industry in Poland has been confronted with its counterparts in the above countries in terms of the quality of raw material supplies, the worth and structure of production of dairy products, labour efficiency, and production concentration. The article takes advantage of secondary source data published in dairy industry reports and Eurostat data. The results of analyses are presented in current and comparable prices, considering their buying power in the analyzed EU countries. This ensures a more objective assessment of the analyzed problems. The year-averaged changes in the data were calculated using the compound percent method.

The following research hypothesis was proposed: *The Polish dairy industry still does not fully exploit its competitiveness potential, and is mostly composed of a production potential similar to a country that only exports raw materials. Furthermore, the potential of the milk processing industry and the competitive potential in the international market have also not been effectively exploited.*

Raw material base

An assessment of the raw material base of the dairy industry in Poland must take into account the following parameters: the number of dairy cows, the milk yield, the volume of milk production, and the milk sales to total milk production ratio. The number (livestock) of dairy cows is the principal factor

that contributes to the base for supplying the dairy industry with raw material. Poland is a leading country among the Central and Eastern European block with regard to the number of dairy cows. Its contribution to the total number of cows in the EU-28, which in 2017 was 9.3%, meant that Poland secured third place in the entire European Union (*Agrarmärkte*, 2017). More dairy cows were found only in Germany and France. In most EU countries, a constant reduction in the stocks of dairy cows can be observed. In Poland, the number of dairy cows between 2010 and 2016 decreased at a year-average rate of 2.3% (Fig. 1).

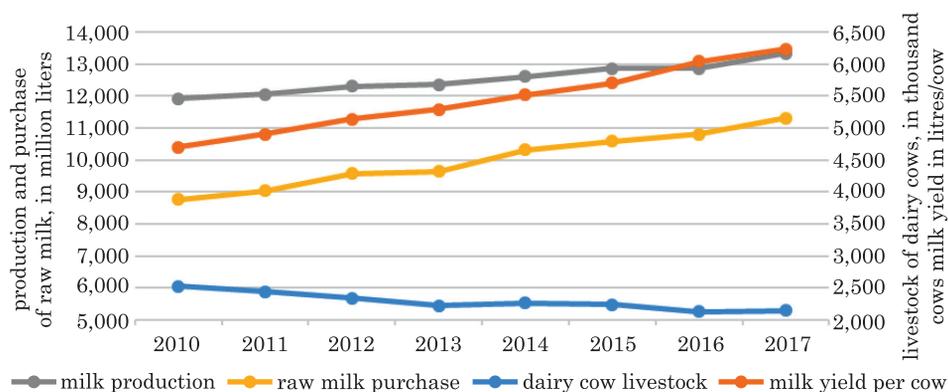


Fig. 1. Livestock and milk yields of cows, as well as the production and purchase of milk as a raw product

Source: diagram developed by the author, based on: *Rynek Mleka. Stan i Perspektywy* (2018, no 54).

To achieve an adequate and complete evaluation of the raw material base for the dairy industry in every country, the information about the number of dairy cows needs to be supplemented by adding the data on milk yields. Unlike the number of cows, the milk yield in the analyzed period increased. In Poland, the milk yield of cows in 2010–2017 increased by nearly 4.1% on average each year, which was faster than in Germany, where the increase was 1.7%. However, the milk yield of dairy cows in Poland is still lower by about 33% than the average milk yields obtained by cows in Germany. In 2016, Poland's share of milk production in the whole EU-28 was 8.5%, thus being lower than its share of the dairy cow livestock (9.0%) (Nowak, 2016).

The sales to total production ratio in the raw milk production base mostly depends on the quantities of milk delivered to plants which process this raw product, which in practice corresponds to milk wholesale purchases. In 2010–2017, Poland recorded a year-average increase in raw milk purchases of about 3.8%, as a result of which the amount of raw milk bought by dairy plants in 2017 was 11,313 thousand litres (i.e. 23% more than in 2010) (Zuba-Ciszewska, 2019).

The final form of an assessment of the raw material base for the dairy industry in Poland, compared to selected EU countries, chosen in this study consisted

of the Principal Component Analysis. This analysis enables us to transform a given set of non-correlated traits (variables) into a new set of characteristics (i.e. principal components), which is comparable to the original set (see: Statistica, online). The first stage of the PCA was composed of building a matrix of correlations between the original variables: dairy cow livestock, milk yield of cows, milk production volume, sales to total production ratio, and raw milk purchases. The cases consisted of the countries analyzed at six time points: in 2000, 2003, 2007, 2010, 2013, and in 2016. The second step employed the Kaiser criterion, to determine the number of principal components, as a result of which two independent (non-correlated) factors were obtained, which together explained 96% of the variation comprised in the primary data. The eigenvalues of factors equaled: 3.1 for the first factor and 1.7 for the second factor. Denotation of the new variables was made possible by so-called factor loads, which define the degree of saturation of a principal component with the given variable. The higher the correlation coefficient for the correlation of the principal component with the variable, the more significant it is for the main principal component. In the final stage of the analysis, the analytical factors were submitted to a *varimax* orthogonal rotation, which showed that the first factor was correlated with the variables: number of dairy cows (0.89), milk production (0.98) and raw milk purchases (0.93), while the second factor was correlated with the variables: cows' milk yield (0.93) and milk sales to total production ratio (0.77).

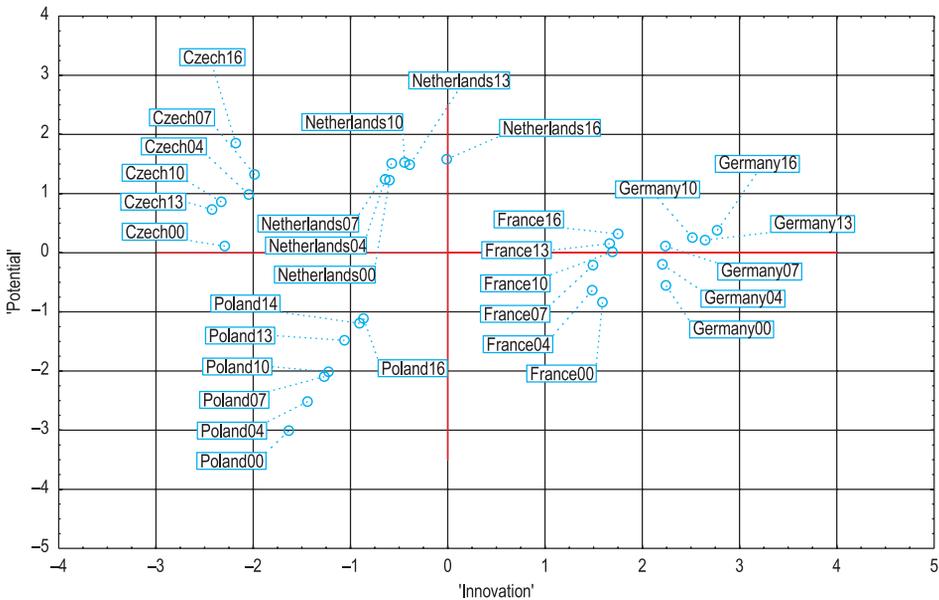


Fig. 2. Map illustrating the positions of selected EU countries with respect to the factors: potential and innovation, in the years 2000, 2003, 2007, 2010, 2013, and 2016

Source: the author, based on: Rynek Mleka. Stan i Perspektywy (2014, no 47-54); *Agrarmärkte* (2017).

The following conventional terms were designated to the distinguished factors: potential (factor 1) and innovation (factor 2).

Figure 2 presents a map of the analysed EU states in 2010-2016, positioned with respect to one another according to the factors 'potential' and 'innovation'. The raw milk base in all the analyzed countries was characterized by a rising value of the factor 'innovation'. Compared to the analyzed EU states, the raw milk base in Poland should be described as traditional, but having great potential concerning the assumed evaluation parameters. In 2010-2013, there was a relatively slow increase in the rate of growth in the parameters which define the innovative nature of the raw milk base. This growth rate has accelerated in recent years, mostly because of more rapid changes in the structure of cow use in Poland, which in turn is a consequence of the abolishment of milk production quotas in the EU.

Production of dairy products

Resource base restructuring and the modernization processes of the raw milk base for the dairy industry in Poland have had a strong impact on the development and changes in the production structure of the final dairy products. Following the above transformation, Poland has become the fourth largest producer of dairy goods in the EU, having an 8.3% share in the dairy production of the whole EU (Wiater *et al.*, 2019). Poland has been surpassed in this regard only by France (19.1%), Germany (17.8%) and Italy (11.9%). The years 2008-2016 were a period of dynamic growth for Poland's dairy industry. The rate of growth in total dairy production in Poland, measured by the worth of sold production, was the highest in the entire EU. At that time, the value of dairy goods sold in the EU (in comparable prices) increased by 7.6% while in Poland it rose by 29% (Tab. 1).

As their economic situation improves, consumers expect increasingly better quality, which is manifested, for example, by a growing demand for highly processed products. Polish companies in the dairy industry, while attempting to meet this rising demand, have adopted a strategy of intensively developing highly processed products, mainly ripened cheeses, milk beverages, desserts and ice creams (Fig. 3) (Kowalska *et al.*, 2019).

After Poland's accession to the EU in 2004, the production output of consumer milk increased greatly as well. In 2004-2017 the year-averaged rate of growth in the production of this product was 5.3%.

Due to the limited subsidies under the Common Agricultural Policy (CAP) allocated to butter production, in most EU countries the production output of this product was observed to have stabilized in 2004-2013. As the demand for butter rose in world markets, the production of butter in Poland increased by 20% in 2017 as compared to 2013. The year-averaged rate of growth

Table 1

Production of dairy products in the selected EU countries

UE states	The value of production in prices [mld euro]:								Average rate of growth of the dairy industry production worth [% annually]			Production in 2016 [Euro/capita]
	current				comparable*				2008-2015	2008-2012	2013-2016	
	2008	2010	2013	2016	2008	2010	2013	2016				
Poland	5.8	5.8	7.1	6.2	8.5	9.8	12.7	11.5	4.2	7.2	1.4	312
Lithuania	0.8	0.8	1.1	0.9	1.3	1.2	1.7	1.4	0.5	3.1	-2.0	486
Hungary	1.1	0.9	0.9	0.8	1.6	1.4	1.6	1.4	-0.5	-1.4	0.3	171
Slovakia	0.6	0.5	0.6	0.5	0.8	0.7	0.9	0.8	-0.3	0.5	-1.0	164
Belgium	3.9	4.0	4.5	4.2	3.6	3.7	4.2	3.8	0.5	1.1	0.0	330
Germany	26.5	23.3	29.3	23.5	25.6	22.4	28.4	22.8	-0.6	0.1	-1.4	317
France	25.7	24.6	28.8	26.2	23.5	22.5	26.8	24.3	0.5	0.9	0.2	414
The UK	9.2	9.5	10.9	8.4	8.2	8.5	9.4	6.9	-1.3	-0.1	-2.5	138
Italy	16.7	14.6	18.1	17.1	16.7	14.6	17.7	17.1	0.6	1.6	-0.5	282
UE-27/28	133.3	123.5	148.4	130.0	133.2	123.4	148.1	129.7	0.1	0.1	0.0	286

* in comparable prices, i.e. current prices corrected by the parity of the buying power of the Euro in analyzed countries

Source: the author, developed from Eurostat data.

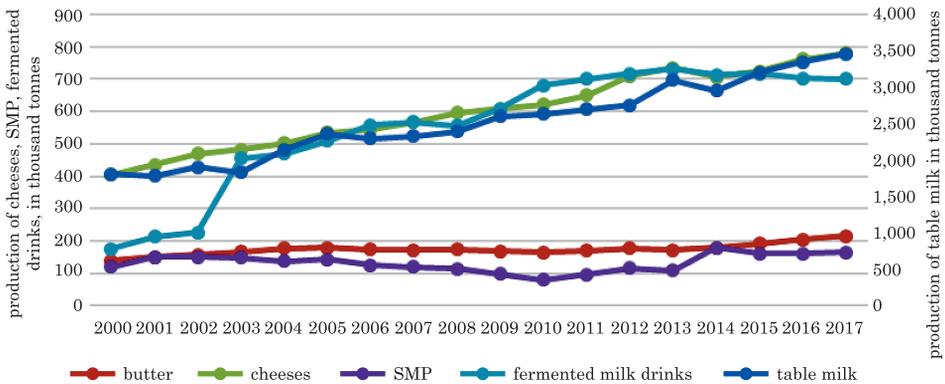


Fig. 3. Production of basic dairy products in Poland

Source: the author, based on data from Rynek Mleka. Stan i Perspektywy (2014, no 47-57).

in the production of butter in Poland over the analyzed time period was 5.7%, still less by one percentage point than in the entire EU.

The third important group of products in the dairy industry in the EU is composed of cheeses, whose production in most of the EU states has been distinguished by a constant growing tendency. Likewise, the quantities of cheese made in Poland increased considerably, from 501 thousand tonnes in 2004

to 780 thousand tonnes in 2017, and the year-averaged growth rate over that time period was 3.45%. Considering the fact that cheeses are highly processed products, the growing trend in their production in Poland should be perceived as a positive manifestation of changes in the structure of milk processing in our country.

Another group of dairy products having high added value are fermented dairy beverages, whose volume of production in Poland over the years 2004-2017 increased by 33%. In 2017, the Polish dairy industry produced over 702 thousand tonnes of these products, which corresponded to 7.2% of the total volume of fermented milk drinks produced in the EU-28 states.

By comparing the share of a given country in the production of dairy products in the EU-28 states with the share of this country in the raw milk purchase in the EU-28 states, it is possible to evaluate a degree of specialization in the production of all groups of products. The graphic presentation of this analysis for Poland and Germany (for comparison) can be seen in Figure 4. The data have been shown in the form of a pentagon, where each vertex represents a given product, i.e. table milk, butter, cheeses, skimmed milk powder (SMP) and fermented milk drinks. The distance from the central point reflects the degree of specialization of a given country in a given group of products. An analysis of both diagrams implicates differences in the production profiles of the compared countries. An analysis of Poland's production profile indicates a gradually diminishing gap in the production of products with high added value relative to Germany, which represents here all countries with a highly developed dairy industry. An analysis of the structure of the Polish dairy industry's production in 2000-2016 shows a significant increase in the share of this group of products in the value of all sold products.

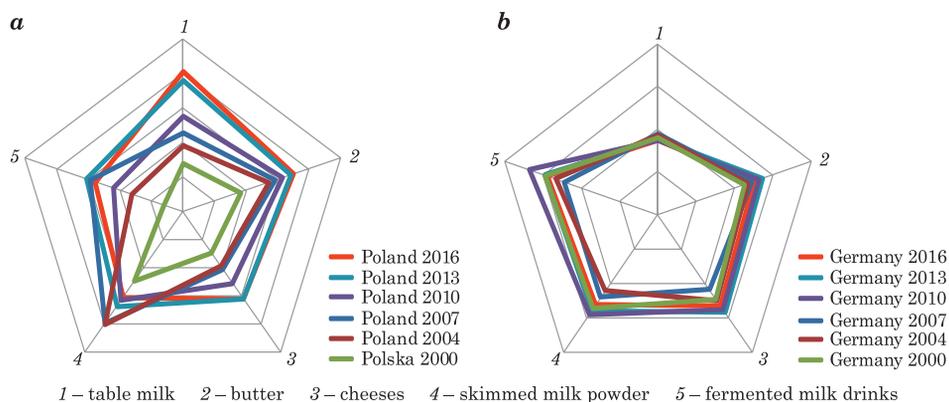


Fig. 4. Graphic specification of the production profiles of dairy industries in Poland (a) and Germany (b) in 2000-2016

Source: the author, based on: Rynek Mleka. Stan i Perspektywy (2014, no 47-54); *Agrarmärkte* (2017).

International trade in dairy products

The positive changes occurring in the structure of groups of products made by the Polish dairy industry are driven by changes in consumer preferences and, on the other hand, are a consequence of the restructuring and modernization of this sector. Owing to these processes, the Polish dairy sector now has an up-to-date potential which enables the industry to produce high quality products with a high added value. This is an essential factor that plays a crucial role in the growth of dairy product exports.

International trade is one of the principal determinants of the growth of economies of entire states, business sectors and companies which these sectors are composed of (Irwin, 2002). Hence, international trade has long been considered to be an important contributor to the development of the Polish dairy industry. Poland used to be a large exporter of butter in the inter-war years; for example it exported 28.7 thousand tonnes of butter in 1938. This quantity of exported butter was not surpassed until the year 2005 (Gornowicz, 2003).

For many years, and particularly after Poland's access to the European Union, Poland has had a positive balance in the international trade of dairy products. Since 2004, the Polish export in terms of its worth has risen by an average of 14.3% annually, to reach the value of 2.12 billion Euro in 2017. Owing to this high rate of growth in import (23.4% a year on average), its value in 2017 was nearly 960 million Euro, and was therefore demonstrably lower than the value of exported dairy goods. As a result, the positive balance in international trade in dairy products nearly doubled in 2017 compared to 2004 (Fig. 5).

Besides this impressive increase in the volume of international trade in dairy products, the structure of their exports has improved as well (Fig. 6). Prior to Poland entering the EU, the share of semi-raw products in the total exports of dairy products from Poland was between 60 and 80%. After the accession, the percentage of ready-made products increased considerably. In 2016, the highest share in the value of exported dairy products was made up by cheeses (39.3%, while the share of skimmed milk powder fell to 11.9%.

To summarize, this analysis of the foreign trade in dairy products is a synthetic comparison made between the profiles of the main exports of dairy products (Fig. 7). Similar to fig. 4, Poland and Germany are presented in the form of a pentagon (Fig. 7). Each vortex of this pentagon symbolizes a specific product: table milk, butter, SMP, cheeses and yoghurts. The distance to the central point reflects the degree of specialization of a given country in exporting a given product. An analysis of figure 7 will reveal the distance between Poland and the so-called old EU member states (EU-15), in our case represented by Germany. In 2002-2004, Poland was strongly orientated towards exporting SMP. It was not until its integration with the EU that the contribution of other products, particularly cheeses and fermented milk drinks, increased.

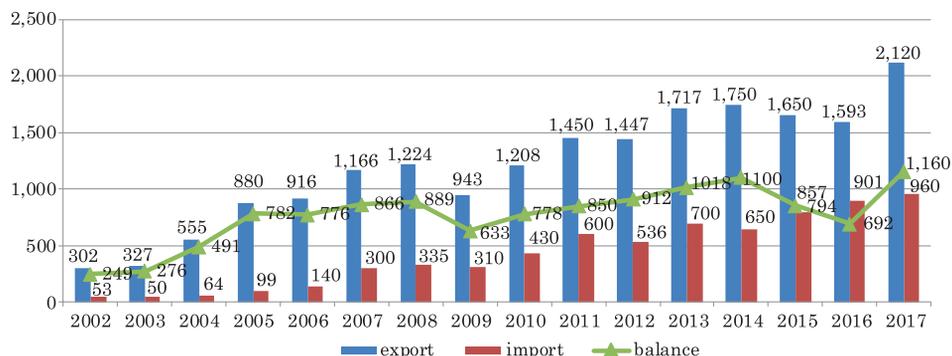


Fig. 5. International trade in dairy products in Poland, in million EUR
 Source: the authors, based on: Rynek Mleka. Stan i Perspektywy (no 47-54,2014-18);
 Agrarmärkte (2017).

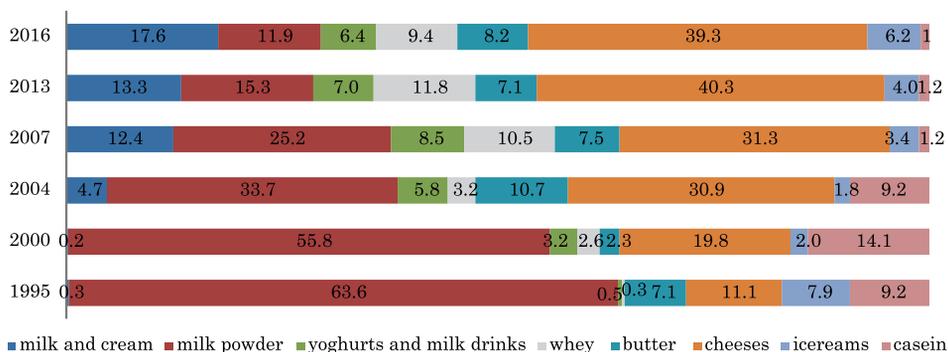


Fig. 6. Structure of the value of Polish trade in dairy products in international markets
 Source: the authors, based on: Rynek Mleka. Stan i Perspektywy (2014, no 47-54);
 Agrarmärkte (2017).

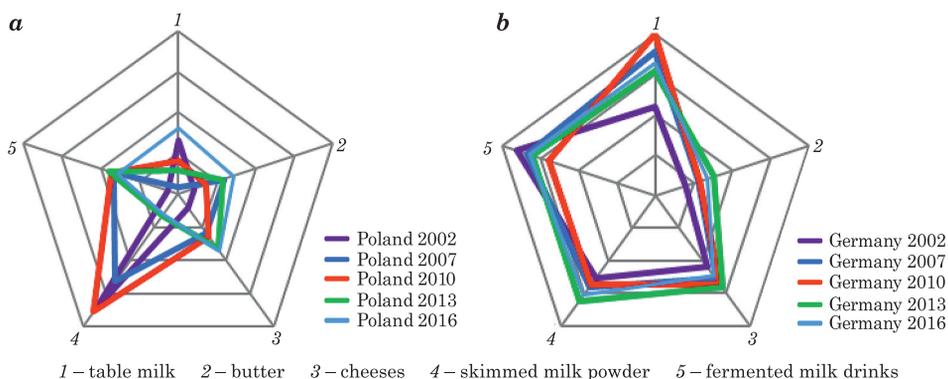


Fig. 7. Graphical comparison of the export profiles for the main dairy products in Poland (a) and Germany (b) in the years 2002-2016
 Source: the authors, based on: Rynek Mleka. Stan i Perspektywy (2014, no 47-54);
 Agrarmärkte (2017).

Changes which have taken place in the foreign trade of dairy products in Poland after its access to the EU can be deemed to be very positive. Besides the increased positive balance of the international trade in these products, in terms of both their worth and quantity, another positive and desirable trend is a rising share of highly processed products in both import and export trade. An increase in the export of cheeses, yoghurts and butter from Poland enables the producers to gain higher benefits owing to the greater added value and the economics of scale. However, a comparison of the exports from Poland and from the EU-15 countries suggests that the Polish dairy sector still possesses an unused potential to raise the percentage of highly processed products in the structure of exported dairy commodities. Activating this potential will have a significant influence on strengthening the competitive edge of the Polish dairy sector.

Labour efficiency in the EU dairy industry

In the practice of measuring labour efficiency, several economic and financial categories are employed, e.g. added value, operating profit or value of sold production (Ikeda, 2009). In general, labour efficiency is understood as the quantity or monetary value of production generated in a time unit by one worker in a given economic sector (Gołaś, 2017).

In 2017, the Polish dairy industry employed around 39.5 thousand people, which corresponded to 10.7% of the total labour force in the EU dairy industry. This placed Poland in the fourth position among the EU-28 states. A higher level

Table 2

Labour efficiency in the dairy industry in the EU

EU states	Labour efficiency in comparable prices [thousand EUR/worker]							Changes in labour efficiency [% annually]		
	2008	2010	2012	2013	2014	2015	2016	2008-2016	2008-2012	2013-2016
Poland	198.1	229.0	274.8	314.7	321.7	297.3	290.6	4.91	8.53	1.40
Lithuania	151.4	166.3	191.3	222.9	223.9	191.5	185.2	2.55	6.02	-0.82
Hungary	192.7	181.2	211.1	219.9	237.5	224.7	212.8	1.25	2.31	0.20
Slovakia	231.4	187.9	242.6	267.8	284.9	256.2	237.8	0.34	1.19	-0.50
Belgium	478.8	508.0	516.5	600.1	641.8	561.4	541.6	1.55	1.91	1.19
Germany	623.4	580.7	580.5	652.8	603.9	559.0	515.2	-2.35	-1.77	-2.94
France		390.6	434.9	467.6	477.6	443.4	397.9	0.31	5.51	-2.20
the UK	262.2	268.7	302.1	303.5	325.1	275.5	245.4	-0.83	3.60	-5.07
Italy	380.9	351.7	403.4	413.6	417.9	417.6	391.4	0.34	1.45	-0.76
UE-27/28	360.1	342.8	365.3	393.3	434.7	390.7	352.4	-0.27	0.35	-0.89

Source: the authors, based on data from Eurostat.

of employment was only found in France (57 thousand), Germany (44 thousand) and Italy (43.5 thousand). In 2008-2016, the number of persons employed in the milk processing industry in Poland decreased by 5%, meanwhile it increased in the EU-28 by 3%.

The highest increase in labour efficiency in the dairy industry over the analyzed time period (in comparable prices) was noted in Poland, where it rose by 47%. A high rate of increase in labour efficiency occurred in 2008-2012 (8.5% annually), while the subsequent time period of analysis (2013-2016) was characterized by a slower growth rate (1.4% annually). Moreover, despite the improved labour efficiency in the Polish dairy industry, this parameter is still lower than the EU average by 17.6%. This means that further improvement is possible and the gap between Poland and more developed countries of the EU can be diminished (Tab. 2).

The concentration of milk processing plants in Poland and in the EU

There were 290 companies operating in the Polish dairy industry in 2016, which corresponded to 3.6% of all dairy companies in the EU. In 2008-2016, the number of these companies in Poland declined by 20.5%, while the total number of dairy companies in the EU remained practically unchanged. As a result, an over 70% increase in the average turnover of Polish dairy

Table 3

Average value of the turnover of companies in the dairy industry in the EU, measured by the worth of production (in comparable prices)

EU countries	Value of the turnover in comparable prices [million EUR/company]							Annual change [%]		
	2008	2010	2012	2013	2014	2015	2016	2008-2016	2008-2012	2013-2016
Poland	23.1	32.0	37.1	44.8	47.6	42.1	39.10	7.26	12.65	2.13
Lithuania	22.2	39.9	41.6	44.4	41.3	56.7	54.72	11.67	15.31	8.14
Hungary	18.0	14.3	17.3	18.2	19.5	18.3	16.70	-0.10	-1.63	1.46
Slovakia	24.2	10.7	12.3	14.3	12.4	10.7	8.81	-11.20	-16.10	-6.01
Belgium	35.2	30.7	31.4	40.9	41.0	39.1	46.76	3.30	-2.97	9.98
Germany	88.6	77.6	76.3	93.6	104.8	87.5	69.80	-2.13	-2.81	-1.45
France	21.3	24.0	28.7	29.1	33.6	30.9	29.59	3.84	9.13	1.29
the UK	26.9	27.7	25.0	27.3	28.0	25.2	18.61	-3.74	-4.33	-3.15
Italy	5.8	5.3	5.5	5.8	5.6	5.4	5.38	-0.62	0.15	-1.39
UE-27/28	14.6	13.7	15.0	15.9	16.5	16.0	14.09	-0.05	0.29	-0.39

Source: the author, based on the Eurostat data.

companies was achieved in 2008-2016. This turnover was 178% higher than the average turnover of the EU-28 dairy companies in the last year of our analysis, i.e. in 2016. Such a large decline in the number of economic entities and an increase in the turnover of an average enterprise was a consequence of the progressing concentration and consolidation process in the Polish dairy sector. This factor has become an important stimulant for growth in the economic power and competitiveness of Polish dairy plants in the EU market.

Conclusion

The foreign trade outcome and the analysis of competitiveness conducted in this study demonstrate that the Polish dairy industry has achieved a measurable success in the EU markets. A further strengthening of the position of Polish dairy producers in the EU market will require a systemic and consistent reinforcement of the developed comparative advantages. Our analysis of the raw milk base for the dairy industry in Poland showed its high potential to produce milk, both in the context of its quantities and quality. The key role in the use of raw milk will be played by the integration in the sense of coordinated efforts undertaken by milk processing and milk producing subjects.

Changes in the production profile of the Polish milk processing sector, presented in this paper, demonstrate diminishing gaps in the production of high added value products relative to the EU countries with well-developed dairy industries.

Owing to the beneficial transformations in the structure of dairy products made and the cost and price advantage, Polish dairy plants have been steadily increasing their export to EU countries. However, the competitive advantage of our dairy companies, understood as a favourable ratio of price to quality of products, has been gradually decreasing (Szczepanek & Tereszczuk, 2017). Hence, any further growth in the export of Polish dairy products will require more intensive promotional campaigns, so that European consumers may identify Poland with a greater array of dairy products. More active promotion in foreign markets will entail large costs, and therefore it seems reasonable to implement such advertising campaigns that will encompass groups of producers or even the entire dairy sector (Szczepanek, 2017).

A significant source of improved export potential for the Polish dairy industry consists of a further rise in labour and capital productivity, which in turn will arise from the implementation of the subsequent stages in the restructuring of the milk processing and production sector.

Having analyzed the research results within the context of the hypothesis, it can be concluded that the hypothesis has been positively verified.

References

- Agrarmärkte*. (2017). Bayerisches Staatsministerium für Ernährung, Landwirtschaft und Forsten.
- Eurostat. (2018). Retrieved from <https://ec.europa.eu/eurostat/data/database> (access 10.09.2018).
- Gołaś, Z. (2017). Determinants of milk production profitability of dairy farms in the EU member states. *Problems of Agricultural Economics*, 3(352), 19-40. <https://doi.org/10.5604/00441600.1245843>.
- Gornowicz, M. (2003). *Polish dairy in the context of competitiveness on the uniform EU market*. Olsztyn: Wydawnictwo UWM.
- Ikeda, Y., & Souma, W. (2009). International comparison of labor productivity distribution for manufacturing and non-manufacturing firms. *Progress of Theoretical Physics Supplement*, 179, 93-102. <https://doi.org/10.1143/PTPS.179.93>.
- Irwin, D.A. (2002). *Free Trade under Fire*. Princeton University Press.
- Kowalska, A.S., Olszańska, A., & Nabiałek, P. (2020). *Production and external trade of dairy products in Poland*. Conference: International Business Information Management Association Conference (IBIMA) 10-11 April 2019, Granada, Spain: Innovation Management and Education Excellence Through Vision 2020.
- Nowak, M.M. (2016). Resource base of the dairy industry in a regional frame. *SERiA, XVIII*.
- Rynek Mleka. Stan i Perspektywy. (2014-2018). No 47-56. Warszawa: Instytut Ekonomiki Rolnictwa i Gospodarki Żywnościowej – Państwowy Instytut Badawczy.
- Statistica, Retrieved from <http://www.statsoft.pl/textbook/stfacan.html> (access 30.09.2018).
- Szczepanek, I., & Tereszczuk, M. (2017). Confronting the Polish dairy industry with the international competition in the EU food market. *Review of Socio-Economic Perspectives*, 2(2).
- Wiater, J., Boruszko, D., Dąbrowski, W., Żyłka, R., & Antonowicz, S. (2019). Evaluation of sustainable development of dairy industry in Poland. *Ekonomia i Środowisko*, 2(69).
- Zuba-Ciszewska, M. (2019). Structural changes in the milk production sector and food security – the case of Poland. *Annals PAAAE*, 21(2), 318-327. <https://doi.org/10.5604/01.3001.0013.2069>.

