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# ASSESSMENT OF THE QUALITY OF SWARD FROM THE GRASSLANDS OF SELECTED ORGANIC FARMS

*Summary*

*Sward, both in its raw form and processed into silage, can be a valuable form of fodder for beef and dairy cattle throughout the year. Existing research data clearly indicate that in Poland neither sward nor hay provide adequate levels of calcium, phosphorus, magnesium, zinc or provitamin A (beta-Carotene) to meet the needs of cattle. To assess the quality and mineral content of sward, six organic farms were selected, all of which utilise fodder from permanent grassland as the principal feed for their dairy cattle: green fodder from pasture in the summer months and silage during winter. In accordance with the principles of organic farming the surveyed farms did not use inorganic fertilizers to fertilize their grasslands while two of the six farms also did not use any form of fertiliser during the research period. In order to assess the quality of the sward set aside for fermentation, random samples of green fodder from the second crop were collected for chemical and microbiological analysis. The analysis determined the levels of basic nutritional elements, Carotenoid components and macro- and microelement content in the sward, including the following elements: calcium, phosphorus, magnesium, manganese and zinc. For each pasture grass sample the survey also assessed the number of colony forming units (CFU) of bacteria potentially pathogenic for animals and the number of fungi. The tests indicated very wide fluctuations in the total protein content of green fodder – from 120 to 200g $kg^{-1}$ DM – correlated to the farm, the method by which grassland was fertilized and the presence of leguminous plants in the sward, especially red clover and white clover. The dry matter calcium content of the green fodder averaged 10.0 g $kg^{-1}$ DM and was therefore higher than the published average for sward and silage in Poland (up to 7.2g $kg^{-1}$). Significantly lower values were found for phosphorus and zinc (3.2 g $kg^{-1}$ and up to 100 mg $kg^{-1}$ s. m. of sward) compared to published data: 2.4 g $kg^{-1}$ DM. and 28.8 mg $kg^{-1}$ DM respectively. The sward also contained inadequate quantities of Carotenoid components, including provitamin A, for the needs of dairy cows. Additionally, Salmonella and Escherichia coli faecal bacteria were found in sward from grassland fertilized with manure in two out of four farms.*
***Keywords**: sward, fertilization, nutritional value, hygiene level*

## 1. Introduction

The healthy development of every living organism calls for an essential dose of dietary components derived from water, air and, in the case of farm animals, primarily from concentrated and coarse fodder. Both permanent and temporary grassland are a source of cheap, natural and valuable coarse fodder used in rearing livestock. [1] Historical data indicate that in Poland the average levels of calcium, phosphorus, magnesium, zinc and provitamin A (beta-Carotene) in sward and hay are relatively low compared to the needs of livestock. These results are presented in table 1. [2-4]

Organic farms function under strictly controlled soil and climate conditions, calling for a very rigorous approach to soil fertilisation. In organic farming natural soil fertility is achieved through the use of natural fertilisers as well as methods and substances that sustain soil–based organisms. Manure is the best natural fertiliser, recommended for fertilising grassland, with has beneficial effects for both soil and flora and stimulates the growth of leguminous plants. Despite their many benefits, when used to fertilise permanent grassland natural fertilisers can create a habitat for various pathogens, parasites and microbes which are undesirable in the silage fermentation process, e.g. bacteria of the genus *Clostridium* and *Bacillus*, which have a negative impact on the quality of milk and its suitability for processing. The presence of pathogenic microbes in animal fodder creates the risk of their transfer to processed and raw dairy products and poses a danger to human health. [5-8]

Organic farms use grassland as part of a managed approach to rearing dairy cattle [9] while fodder obtained from meadows and pastures using natural methods often contains too little of the calcium, phosphorus, magnesium, zinc and provitamin A (beta-Carotene) needed by cows. Traditional approaches to feeding dairy cows, based on sward, hay and silage from pasture, often result in calcium and Carotene deficiency which can, to a significant extent, lead to a decline in health, fertility and a fall in productivity. The resulting need to apply vitamins and mineral supplements when feeding livestock is caused by inadequate levels of these components in farm-produced fodder or an improper balance of elements. The content and proportions of vitamin and mineral components in supplements for fodder should be made dependent on their proportions in feed rations for livestock. [2-4].

A lack of inorganic fertiliser means that sward grown on organic farms is similar to natural grassland flora. Sward comprises three groups of plants: grasses, leguminous plants, herbs and weeds. The grasses include meadow fescue (*Festuca pratensis* Huds.), timothy grass (*Phleum pratense* L.), redtop (*Agrostis gigantea* Roth), (*Festuca rubra* L.), red fescue (*Dactylis glomerata* L.), perennial ryegrass (*Lolium perenne* L.) and common meadow-grass (*Poa pratensis* L.). Leguminous plants, principally clovers, represent about 20% of sward: white clover (*Trifolium repens* L.), alsike clover (*Trifolium hybridum* L.) and bird's–foot trefoil (*Lotus corniculatus* L.). Herbs commonly occurring in sward include: valerian (*Valeriana officinalis*), dandelion (*Taraxacum officinale* F. H. Wigg.), meadow sage (*Salvia pratensis* L.), ribwort plantain (*Plantago lanceolata* L.), yarrow (*Achillea millefolium* L.), and hairy lady's mantle (*Alchemilla monticola* Opiz). The category of pasture weeds

Table 1. Macro- and microelement, and beta-Carotene content in the hay and the sward and microelement and mean daily requirement of dairy cows on individual elements acc. to Ruszczyc *, Falkowski, Kukułka and Kozłowski** [2-3]

| Component | Mean content in dry matter of hay and meadow sward | Mean daily requirement of dairy cows |
|---|---|---|
| Calcium (Ca) | 0.33-0.72 % * | 65-115 g * |
| Phosphorus (P) | 0.32 % * | 40-70 g * |
| Iron (Fe) | 0.25 % * | 40-60 ppm * |
| Sodium (Na) | 0.15 % * | 500-3000 ppm* |
| Magnesium (Mg) | 0.12 % ** | 20-30 g * |
| Manganese (Mn) | 40-70 ppm * | 25-40 ppm * |
| Zinc (Zn) | 30-100 ppm * | 60-80 ppm * |
| beta-Carotene | 29.8-61.9 ppm ** | in 1 kg DM forage 40 mg ** |

*Source: Own work / Źródło: opracowanie własne*

Table 2. Characteristics of organic farms selected to assess the sward quality

| No. | Farm area /ha/ | | Soil quality class (PG) | Cows number /heads/ | Applied fertilisation of PG with natural fertilisers | Milk production l/head |
|---|---|---|---|---|---|---|
| | total | in this PG | | | | |
| 1. | 13.37 | 7.62 | V, VI, | 11 | manure, annually in autumn | 4500 |
| 2. | 19.00 | 4.83 | VI | 13 | manure, annually in autumn | 4500 |
| 3. | 26.00 | 5.02 | VI | 12 | manure, annually in autumn | 5500 |
| 4. | 24.40 | 9.50 | VI | 4 | manure, annually in autumn | 4000 |
| 5. | 17.25 | 2.50 | V, VI | 6 | without fertilisation | 3500 |
| 6. | 26.97 | 8.27 | V, VI | 6 | without fertilisation | 4000 |

*PG- permanent grasslands* *Source: Own work / Źródło: opracowanie własne*

includes all plants that reduce the quality of fodder or are poisonous. The exact composition of sward is influenced by soil type and methods of fertilisation and maintenance, the key factors determining the value of fodder from grassland. [10-11].

## 2. Aim of the study

The aim if the study was to assess the quality of sward from organic farms based on the quantities of basic nutritional elements, macro- and microelements, Carotenoids and the contamination of green fodder by microorganisms potentially pathogenic to livestock.

## 3. Materials and methods

The survey was carried out over a period of three years (in 2008, 2009 and 2010) at six organic farms located in the Masovia voivodeship of Poland. Four of the sample farms fertilised their grassland with manure in autumn of each year, the remaining two did not use fertiliser during the research period.

Table 2 shows the area of the permanent grassland which was used to source sward and the type of livestock reared at the farms selected for the study.

Each meadow was divided into squares and samples of mowed sward were randomly selected, mixed and three average samples were collected for chemical and microbiological analysis. At farms 1,2,3 and 4 the dominant plant groups comprising the sward were grasses and legumes, while the sward of farms 5 and 6 was dominated by grasses.

The applied chemical analysis methods included:

- determining dry matter content using the gravimetric method in line with the PN-ISO 6496:2002 standard
- determining the total protein content, raw fibre, raw fat, ash, water soluble hydrocarbons and dry organic matter digestibility using near infrared spectroscopy with a Büchi NIRFlex N–500 spectrometer using presets for dry grasses created by INGOT.
- quantitative determination of chemical elements content using atomic absorption spectroscopy with the Perkin Elmer 1100 spectrometer
- determining the Carotenoid content using calorimetry in line with the PN-90/A-75101/12 standard.

The study used the following microbiological methods:

- Determining the number of *Salmonella* sp. bacteria using Rambach, a specialised agar medium produced by Merck (Darmstadt, Germany),
- Determining the presence of *Escherichia coli* bacteria and other bacteria in the coli group using Petrifilm Select E. coli and Petrifilm coliform/E. coli media made by 3M Heath Care Company (USA, Loughborough),
- Determining the number of *Clostridium perfringens* bacteria using the Agar Base 9188 medium by Neogen,
- Determining the number of fungi on an agar medium using dicloran and an 18% glycerol solution (DG 18) in line with PN ISO 21527-2: 2009 part 2.

The test results were subjected to statistical analysis using Statistica 10.0 software (Statsoft, Poland). Statistical analyses were performed of repeated measurements with one-way ANOVA followed by Tukey's multiple comparison. P-values of $p \leq 0.05$ were considered to be statistically significant.

Table 3. Content of nutrients and dry matter digestibility of meadow sward from the second cut of organic grasslands

| Farm, No, fertilisation | Year of study | Dry matter, g kg$^{-1}$ | Digestibility of organic matter, % | Content of nutritive components in dry mater of meadow sward, g kg$^{-1}$ DM | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | total protein | crude fibre | crude ash | WSC | WSC:total protein ratio |
| 1* | 2008 | 279.5 | 52.85 | 192.2 | 237.2 | 65.2 | 104.0 | 0.54 |
| | 2009 | 323.0 | 52.10 | 187.1 | 252.4 | 62.6 | 91.6 | 0.49 |
| | 2010 | 294.4 | 55.60 | 201.3 | 248.2 | 68.1 | 96.7 | 0.48 |
| | **Mean:** | **299.0** $^{a}$ | **53.52** $^{a}$ | **193.5** $^{a}$ | **245.9** $^{a}$ | **65.3** $^{a}$ | **97.4** $^{a}$ | **0.50** |
| 2* | 2008 | 327.2 | 48.78 | 186.4 | 254.4 | 58.1 | 89.3 | 0.48 |
| | 2009 | 288.3 | 49.56 | 191.2 | 249.1 | 52.5 | 90.9 | 0.48 |
| | 2010 | 298.0 | 52.89 | 223.1 | 262.4 | 57.3 | 88.0 | 0.39 |
| | **Mean:** | **304.5** $^{a}$ | **50.41** $^{ab}$ | **200.2** $^{a}$ | **255.3** $^{ab}$ | **56.0** $^{b}$ | **89.4** $^{a}$ | **0.45** |
| 3* | 2008 | 294.2 | 48.45 | 191.4 | 248.4 | 61.6 | 84.1 | 0.44 |
| | 2009 | 251.5 | 49.28 | 188.2 | 264.6 | 64.2 | 86.3 | 0.46 |
| | 2010 | 278.0 | 47.50 | 197.3 | 254.2 | 57.5 | 87.6 | 0.44 |
| | **Mean:** | **274.6** $^{a}$ | **48.41** $^{bc}$ | **192.3** $^{a}$ | **255.7** $^{ab}$ | **61.2** $^{b}$ | **86.0** $^{a}$ | **0.45** |
| 4* | 2008 | 375.2 | 47.28 | 174.5 | 262.4 | 61.8 | 98.0 | 0.56 |
| | 2009 | 343.4 | 48.24 | 195.2 | 258.2 | 63.1 | 94.6 | 0.48 |
| | 2010 | 290.8 | 46.58 | 170.8 | 270.8 | 57.7 | 86.1 | 0.50 |
| | **Mean:** | **336.5** $^{a}$ | **47.37** $^{bc}$ | **180.2** $^{ab}$ | **263.8** $^{abc}$ | **60.1** $^{b}$ | **93.0** $^{a}$ | **0.52** |
| 5 | 2008 | 329.0 | 47.67 | 166.6 | 275.7 | 53.4 | 99.2 | 0.60 |
| | 2009 | 272.4 | 48.60 | 148.5 | 282.9 | 59.0 | 84.8 | 0.57 |
| | 2010 | 276.3 | 49.46 | 159.1 | 278.1 | 61.2 | 90.5 | 0.57 |
| | **Mean:** | **292.6** $^{a}$ | **48.58** $^{bc}$ | **158.1** $^{b}$ | **278.9** $^{c}$ | **57.9** $^{b}$ | **91.5** $^{a}$ | **0.58** |
| 6 | 2008 | 329.1 | 46.70 | 127.6 | 276.0 | 64.1 | 95.9 | 0.75 |
| | 2009 | 382.3 | 44.78 | 129.3 | 258.2 | 63.7 | 81.0 | 0.63 |
| | 2010 | 346.0 | 45.79 | 118.2 | 280.7 | 67.2 | 76.4 | 0.65 |
| | **Mean:** | **352.5** $^{a}$ | **45.76** $^{c}$ | **125.0** $^{c}$ | **271.6** $^{bc}$ | **65.0** $^{a}$ | **84.4** $^{a}$ | **0.68** |

*WSC - water soluble carbohydrates; * permanent grasslands fertilised with manure*
*Means were separated into statistically different groups marked with letters*

*Source: Own work / Źródło: opracowanie własne*

## 4. Results and discussion

During the research period the selected organic farms were geared towards milk production. In the summer months their cows were allowed to graze on pasture and in the winter they were fed silage from the second mow of sward, which made up around 65% of the daily feed ration, supplemented with hay, straw and a 5% supplement of cereal middlings.

Grasses were the main plant component of sward from the grasslands of the surveyed farms. The leguminous plant component (red clover on meadows and white clover on pasture) depended on the use of fertiliser and was significantly higher at farms that fertilised with manure. The farms that did not use manure on their grassland showed only a small proportion of leguminous plants (a few percent). As well as grasses and leguminous plants we observed numerous species of dicotyledonous plants belonging to the group of herbs and weeds. They represented at most 30% of sward in the farms studied and at least a few percent.

Data describing the nutritional value, macro- and microelement content and hygiene of green fodder set aside for silage production is presented in tables 3, 4 and 5.

The average dry mass of dried sward ranged from 25% to 35% and did not differ significantly from one farm to another. The organic dry mass digestibility ranged from 47.4% to 55.6% in farms 1, 2, 3 and 4, which used manure to fertilise their grassland and from 44.8% to 49.5% in farms 5 and 6, where grassland was not fertilised during the survey. The total protein content in dry mass green fodder from grassland fertilised with manure totalled from 180 to 200 g kg$^{-1}$ DM and was higher in farms 1, 2, 3 and 4 than the protein content in the green fodder from unfertilised grassland (farms 5 and 6), which ranged from 120 to 160 g kg$^{-1}$ DM The results showed a statistically significant relationship between the protein content of green fodder from farms 1, 2, 3 and sward from farm 6. Conversely, the raw fibre content of sward from farms using organic fertiliser was significantly lower (by around 20 g kg$^{-1}$ DM) than that of pasture from farms that did not use fertiliser (a statistically significant correlation was determined between pasture grass from farm 1 and grass from farms 5 and 6). The raw ash content in sward ranged from 52.0 to 68.0 g kg$^{-1}$ DM and in this instance no correlation was found with fertilisation. Fertilisation of grassland using manure was also found to have no correlation with soluble sugar content.

Table 4. Macro- and microelement, and Carotenoid components in the second cut of meadow sward

| Farm, No., fertilisation | Year of study | Content in dry matter of meadow sward | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Carotenoid components, mg kg$^{-1}$ | Ca g kg$^{-1}$ DM | P g kg$^{-1}$ DM | Mg g kg$^{-1}$ DM | Mn mg kg$^{-1}$ | Zn mg kg$^{-1}$ | Ca:P relation |
| 1* | 2008 | 13.06 | 10.3 | 2.3 | 1.8 | 99.05 | 33.80 | 4.48 |
| | 2009 | 11.10 | 10.6 | 2.4 | 1.9 | 101.18 | 35.20 | 4.42 |
| | 2010 | 12.79 | 98 | 2.1 | 1.4 | 102.10 | 33.89 | 4.67 |
| | **Mean:** | **12.32** $^{a}$ | **10.2** $^{ab}$ | **2.3** $^{a}$ | **1.7** $^{a}$ | **100.78** $^{a}$ | **34.30** $^{d}$ | **4.43** |
| 2* | 2008 | 14.35 | 9.6 | 2.5 | 1.8 | 127.20 | 33.24 | 3.84 |
| | 2009 | 15.40 | 10.4 | 2.1 | 2.5 | 117.85 | 36.10 | 4.95 |
| | 2010 | 12.80 | 8.9 | 2.6 | 2.3 | 116.50 | 32.68 | 3.42 |
| | **Mean:** | **14.18** $^{a}$ | **9.6** $^{ab}$ | **2.4** $^{a}$ | **2.2** $^{ab}$ | **120.52** $^{a}$ | **34.00** $^{d}$ | **4.00** |
| 3* | 2008 | 11.68 | 11.4 | 2.4 | 2.8 | 84.80 | 29.16 | 4.75 |
| | 2009 | 13.70 | 10.6 | 2.6 | 2.9 | 92.42 | 31.48 | 4.08 |
| | 2010 | 15.00 | 10.5 | 2.7 | 2.6 | 88.76 | 30.50 | 3.89 |
| | **Mean:** | **13.46** $^{a}$ | **10.8** $^{a}$ | **2.6** $^{a}$ | **2.8** $^{bc}$ | **88.66** $^{a}$ | **30.38** $^{c}$ | **4.15** |
| 4* | 2008 | 13.70 | 8.8 | 2.6 | 1.8 | 98.60 | 24.50 | 3.38 |
| | 2009 | 12.00 | 8.6 | 2.5 | 1.7 | 112.45 | 27.16 | 3.44 |
| | 2010 | 16.05 | 9.2 | 2.8 | 1.8 | 108.68 | 25.10 | 3.29 |
| | **Mean:** | **13.92** $^{a}$ | **8.9** $^{b}$ | **2.6** $^{a}$ | **1.8** $^{a}$ | **106.58** $^{a}$ | **25.59** $^{b}$ | **3.42** |
| 5 | 2008 | 12.78 | 10.4 | 2.5 | 2.9 | 110.35 | 31.26 | 4.16 |
| | 2009 | 13.90 | 9.8 | 2.2 | 2.8 | 111.14 | 29.80 | 4.45 |
| | 2010 | 12.34 | 11.2 | 2.3 | 3.1 | 103.76 | 30.04 | 4.87 |
| | **Mean:** | **13.00** $^{a}$ | **10.5** $^{a}$ | **2.3** $^{a}$ | **2.9** $^{c}$ | **108.42** $^{a}$ | **30.36** $^{c}$ | **4.57** |
| 6 | 2008 | 14.20 | 10.9 | 2.2 | 1.9 | 102.70 | 18.45 | 4.95 |
| | 2009 | 12.90 | 10.0 | 2.5 | 2.4 | 98.69 | 18.30 | 4.00 |
| | 2010 | 14.98 | 9.9 | 2.4 | 2.5 | 103.40 | 17.28 | 4.13 |
| | **Mean:** | **14.03** $^{a}$ | **10.3** $^{ab}$ | **2.4** $^{a}$ | **2.3** $^{ab}$ | **101.60** $^{a}$ | **18.01** $^{a}$ | **4.29** |
| **Mean from years and farms:** | | **13.49** | **10.0** | **2.4** | **2.3** | **104.43** | **28.77** | **4.17** |

** permanent grasslands fertilised with manure*
*Means were separated into statistically different groups marked with letters* *Source: Own work / Źródło: opracowanie własne*

According to Brzóska [12] the bare minimum total protein content in fodder that guarantees the normal functioning of the digestive tract of dairy cattle is at least 150-170 g kg$^{-1}$ DM of fodder while the raw fibre level should not exceed 300 g kg$^{-1}$ DM. The green fodder used as the raw material for the production of fodder for dairy cattle at all the farms surveyed was shown to be adequate in this respect.

The average total quantities of chemical elements in the dry mass of green fodder of all the farms during the research period was as follows: Ca – 10.0 g kg$^{-1}$ DM, P – 2.4 g kg$^{-1}$ DM, Mg – 2.3 g kg$^{-1}$ DM, Mn – 104.43 mg kg$^{-1}$ and Zn – 28.77 mg kg$^{-1}$. Compared to previously published data describing the mineral components of sward and hay in Poland [1] our results for pasture grass higher in terms of calcium content (by 2.8 g kg$^{-1}$ DM), magnesium (by 1.1 g kg$^{-1}$ DM), but lower in terms of the phosphorus content of green fodder (by 0.8 g kg$^{-1}$ DM) and zinc (by 71 mg kg$^{-1}$ DM). The Ca:P mass ratio (on average 4.17) in pasture grass from all farms exceeded the optimum (1.8–2.1), which was the result of inadequate phosphorus levels.

A somewhat different result was obtained by Nazaruk et al. [13] in their work on the mineral content of fodder from the permanent grasslands of organic farms. The average levels of potassium and magnesium in all of the tested varieties of fodder were adequate, while adequate levels of phosphorus were found only in pasture from grasslands. Only in hay were calcium levels found to be slightly below the required norm while sodium levels were exceptionally low across all forms of fodder. [13]

The Carotenoid component of sward from organic farms ranged from 11 to 15 mg kg$^{-1}$ irrespective of the method used to fertlise the grassland and the species composition of the tested green fodder. These levels were found to be inadequate as the dietary requirement of Carotenoids for dairy cattle is 40 mg kg$^{-1}$ of fodder,

It should be stressed that we did not find a statistically significant difference in any of the tested characteristics of sward from one year to the next.

The survey also compared the hygiene level of sward from grasslands fertilised with manure and those that were not treated with manure. The results are presented in table 5.

Table 5. The number of potentially pathogenic microorganisms and moulds in dry matter of sward derived from the surveyed farms (results from years 2009–2010)

| Farm | Year of study | Number of microorganisms in meadow sward, log CFU. $g^{-1}$ DM | | | | |
|---|---|---|---|---|---|---|
| | | *Salmonella sp.* | *Escherichia coli* | coliform bacteria | *Clostridium perfringens* | Moulds |
| 1* | 2009 | 1.00 | 1.00 | 3.60 | 0.30 | 3.60 |
| | 2010 | 1.30 | 1.48 | 4.00 | 1.00 | 4.00 |
| | **Mean:** | **1.15** [a] | **1.24** [a] | **3.80** [a] | **0.65** [a] | **3.80** [a] |
| 2* | 2009 | 0.90 | n.d. | 5.30 | 1.00 | 4.00 |
| | 2010 | 1.00 | n.d. | 5.60 | 2.00 | 4.30 |
| | **Mean:** | **0.95** [a] | **n.d.** [b] | **5.45** [b] | **1.50** [a] | **4.15** [a] |
| 3* | 2009 | n.d. | 0.90 | 5.60 | 1.00 | 3.60 |
| | 2010 | n.d. | 1.30 | 5.80 | 1.65 | 4.30 |
| | **Mean:** | **n.d.** [b] | **1.10** [a] | **5.70** [b] | **1.33** [a] | **3.95** [a] |
| 4* | 2009 | n.d. | n.d. | 5.60 | 1.00 | 4.30 |
| | 2010 | n.d. | n.d. | 5.80 | 1.48 | 4.60 |
| | **Mean:** | **n.d.** [b] | **n.d.** [b] | **5.70** [b] | **1.24** [a] | **4.45** [ab] |
| 5 | 2009 | n.d. | n.d. | 3.00 | n.d. | 5.30 |
| | 2010 | n.d. | n.d. | 3.60 | n.d. | 5.60 |
| | **Mean:** | **n.d.** [b] | **n.d.** [b] | **3.30** [a] | **n.d.** [a] | **5.45** [bc] |
| 6 | 2009 | n.d. | n.d. | 2.30 | n.d. | 5.90 |
| | 2010 | n.d. | n.d. | 3.00 | n.d. | 6.00 |
| | **Mean:** | **n.d.** [b] | **n.d.** [b] | **2.65** [a] | **n.d.** [a] | **5.95** [c] |

** permanent grasslands fertilised with manure; n.d. – not detectable*
*Means were separated into statistically different groups marked with letters* *Source: Own work / Źródło: opracowanie własne*

In two of the four farms that fertilised its grasslands with manure we detected the presence of *Salmonella* and *Escherichia coli* bacteria, while coliform bacteria were found in sward from all four farms. The green fodder of all farms using manure as fertiliser was found to be infected with *Clostridium perfringens* bacteria to a small extent (from 0.30 to 2.00 log CFU $g^{-1}$ DM). Sward from farms which did not use fertiliser (1 – 4) showed a significantly higher level of mould infection (from 5.30 to 6.00 log CFU $g^{-1}$ DM) compared with farms 5 and 6.

The degree of infection of grasslands with faecal bacteria, introduced in with fertilising manure, often corresponds to the level of infection of sward. [14] Davies et al. [15] reached similar conclusions in their study of how bacteria of the order *Enterobacteriaceae* and genus *Clostridium* are introduced into soil through organic fertiliser. Thus introduced, the microbes multiplied in the green fodder and in silage produced from it. [16-17] The infection of sward with pathogens can therefore be a cause of infection of silage, which is why it is essential that they are produced using starter cultures of milk fermenting bacteria with antibacterial properties to combat pathogens. [18-19]

## 5. Conclusions

1. Sward from organic grassland fertilised with manure, compared to sward from unfertilised meadows, was characterised by the presence of leguminous plants and a greater nutritious value, thanks to a total protein content that was higher by two percentage points on average, dry organic matter digestibility higher on average by five percentage points and lower levels of raw fibre.

2. The average macro- and microelement content of all the farms across all the years of the survey was as follows: Ca – 10.0 g $kg^{-1}$ DM, P – 2.4 g $kg^{-1}$ DM, Mg – 2.3 g $kg^{-1}$ DM, Mn – 104.43 mg $kg^{-1}$ and Zn – 28.77 mg $kg^{-1}$ DM. The mineral content of sward and silage was found to be higher than that quoted in historical data for Poland in the case of calcium and magnesium, but lower in the case of carotenoids, phosphorus and zinc in pasture grass.

3. In two out of four of the farms that fertilised their grasslands using manure, the sward was found to contain *Salmonella* and *Escherichia coli* bacteria, while coliform bacteria were detected in all four farms.

4. Contamination of green fodder with *Clostridium perfringens* bacteria was found in all farms using manure as fertiliser, but to a minor extent (from 0.30 to 2.00 log CFU $g^{-1}$ DM). We also found that mould infection was more prevalent in sward originating in farms that did not use fertiliser on their grasslands.

## 6. References


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# OCENA JAKOŚCI RUNI ŁĄKOWEJ Z UŻYTKÓW ZIELONYCH W WYBRANYCH GOSPODARSTWACH EKOLOGICZNYCH

*Summary*

*Ruń łąkowa i sporządzane z niej kiszonki mogą być wartościowymi paszami objętościowym stosowanymi w całorocznym żywieniu bydła mięsnego i mlecznego. Na podstawie danych literaturowych wiadomo, że w Polsce w stosunku do zapotrzebowania zwierząt, zarówno ruń łąkowa jak i siano łąkowe, zawierają zbyt mało wapnia, fosforu, magnezu i cynku oraz prowitaminy A czyli beta-karotenu. Do badań dotyczących oceny jakości i zawartości składników mineralnych w runi łąkowej wybrano sześć gospodarstwach ekologicznych, w których pasze z trwałych użytków zielonych są podstawą żywienia krów mlecznych, w okresie letnim jest to zielonka pastwiskowa, a w okresie zimowym - kiszonka. Do nawożenia użytków zielonych w gospodarstwach ekologicznych obligatoryjnie nie stosuje się nawozów mineralnych, a w dwóch z sześciu gospodarstw doświadczalnych, w latach, w których prowadzono badania, nie stosowano również nawozów naturalnych. W celu oceny jakości runi łąkowej przeznaczonej do zakiszania losowo pobrano próbki zielonki łąkowej z II pokosu, które następnie poddano analizie chemicznej i mikrobiologicznej. W runi oznaczono zawartość podstawowych składników pokarmowych, związków karotenoidowych, oraz zawartość makro- i mikroelementów, z uwzględnieniem następujących pierwiastków: wapnia, fosforu, magnezu, manganu i cynku. W próbach zielonki oznaczono również liczbę j.t.k. bakterii potencjalnie patogennych dla zwierząt oraz liczbę pleśni. Na podstawie przeprowadzonych badań stwierdzono, że zawartość białka ogólnego w zielonce wahała się w bardzo szerokich granicach od 120 do 200 g $kg^{-1}$ s.m. i zależała od gospodarstwa, sposobu nawożenia użytków zielonych oraz udziału w runi roślin bobowatych, a zwłaszcza koniczyny łąkowej i koniczyny białej. Zawartość wapnia w suchej masie zielonki wynosiła średnio 10,0 g $kg^{-1}$ s.m., czyli była wyższa od podanej w literaturze wartości średniej dla runi i siana w Polsce (do 7,2 g $kg^{-1}$). Zdecydowanie niższe wartości uzyskano dla fosforu i cynku (3,2 g $kg^{-1}$ i do 100 mg $kg^{-1}$ s. m. runi) w porównaniu z danymi literaturowymi, które wynosiły odpowiednio 2.4 g $kg^{-1}$ s.m. oraz 28,8 mg $kg^{-1}$ s.m. Niewystarczająca była również w runi zawartość związków karotenoidowych (13 mg $kg^{-1}$ s. m.), w skład których wchodzi prowitamina A, w stosunku do zapotrzebowania krów mlecznych. Ponadto w runi łąkowej pochodzącej z użytków zielonych nawożonych obornikiem, w dwóch gospodarstwach na cztery, wykryto obecność bakterii fekalnych z rodzaju Salmonella oraz z gatunku Escherichia coli.*

***Słowa kluczowe:*** *ruń łąkowa, nawożenie, wartość pokarmowa, stan higieny*