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OCCURRENCE OF MOULDS IN REPRODUCTIVE GOOSE FLOCKS IN SOUTHERN-EASTERN POLAND

GRAŻYNA ZIÓŁKOWSKA AND STANISŁAW TOKARZEWSKI

Institute of Biological Rudiments of Animal Diseases, Department of Veterinary Microbiology, Faculty of Veterinary Medicine, University of Agriculture, 20-033 Lublin, Poland
stanislaw.tokarzewski@ar.lublin.pl

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Abstract

The aim of study was the evaluation of a mould incidence in reproductive goose flocks in relation to their environmental conditions. The studies covered 17 farms of reproductive White Italian goose breed in the southern-eastern region of Poland. The flock ranged from 190 up to 800 birds provided with permanent veterinary care. The prophylactic programmes included vaccination against Derzsy`s disease as well as regular treatment with anthelmintics. The research focused on the assessment of mycotic flora, mainly because the moulds occur in geese, and are related to the flock size, type of farm building, laying season, and the month in the year. The samples of swabs from the beak cavity and cloaca were collected from 10 randomly selected birds from each flock. Totally, 920 samples from 460 geese were examined. To isolate the moulds, the material was inoculated on the Sabouraud solid medium supplemented with chloramphenicol and incubated together at 25°C and 37°C for about 14 d. In the monitored flocks, a high rate of birds contaminated with the moulds was recorded. The presence of fungi was found in 335 (72.8%) of the birds. From the collected material 19 genera of fungi were obtained and their incidence frequency was highly different. The following fungi were most often isolated: *Cladosporium* sp. (19.57%), *Acremonium* sp. (18.04%), *Aspergillus* sp. (13.91%), and *Penicillium* sp. (12.83%), while some rarer ones proved to be *Altenaria* sp. (7.83%), *Paecilomyces* sp. (7.61%), *Mucor* sp. (7.17%), *Scopulariopsis* sp. (6.09%), *Chrysosporium* sp. (5.66%), and *Fusarium* sp. (4.13%). The other genera of fungi, i.e. *Pithomyces* sp., *Sporothrix* sp., *Scedosporium* sp., *Trichosporon* sp., *Verticillium* sp., *Phoma* sp., *Trichothecium* sp., *Chaetomium* sp., and *Beauveria* sp. occurred sporadically and their isolation percentage oscillated from 3.48% to 0.87%. Among *Aspergillus* sp., *Aspergillus fumigatus* (66%), *A. versicolor* (17%), and *A. flavus* (9%) dominated. *A. glaucus*, *A. nidulans,* and *A. clavatus* occurred sporadically and their isolation percentage ranged from 2 up to 4%.

Key words: geese, mycoses, moulds, *Aspergillus fumigatus*.

Recently, the growth of fungal infections incidence has been recorded, especially so-called opportunistic mycoses that, beside humans and different species of mammals, affect birds to a great degree (4, 10). Although more and more improved technologies of poultry production are implemented and high hygienic-sanitary conditions maintained, a level of bird infection and habitat contamination has maintained its high level.

The opportunistic infections are most often produced by commensal fungi, like *Candida albicans* (36) or saprophytes of *Aspergillus* sp. (2). Currently a new problem emerges, namely infections with fungi that have been sporadically associated with disease processes so far. This group includes, among others, *Aspergillus nidulans*, *Aspergillus flavus*, *Aspergillus clavatus*, fungi from *Fusarium* sp., *Acremonium* sp., *Scedosporium* sp., *Paecilomyces* sp., and *Mucor* sp. (27, 35) as well as non-albicans species of *Candida* (*C. glabrata*, *C. krusei*, *C. tropicalis*), *Cryptococcus* sp., and *Trichosporon* sp. (21, 37). Generally, these moulds compose the microflora of air and feed and contact with them, in particular in close confined areas, is a common effect. Most mycotic infections affect the respiratory or alimentary tracts of birds.

Conversion of opportunistic and saprophytic fungi into a pathogenic form is most often preceded by the impairment of the birds' immunity or by some disorders in the composition and functioning of microflora of every ontocenosis.

The epidemiological examinations revealed high differentiation of the mycoflora depending on the environmental conditions as well as its permanent qualitative and quantitative variation (4). Thus, performing the periodical monitoring of pathogenic fungi incidence is of vital importance from an epidemiological and prophylactic point of view (4). The studies of this type, yet in a limited scope, have been primarily conducted on humans. Therefore, there is relatively little literature that addresses the mycotic microflora in animals, regarding its development and changes.

With regard to the substantial increase of the role of fungi as direct or potential pathogens for a human or animal organism, as well as potential health hazard posed by a direct contact with infected birds or food of animal origin; the objective of the present work

was to evaluate the occurrence of moulds in the reproductive goose flocks, depending on their environmental conditions.

Material and Methods

Animals. The investigations covered 17 farms of reproductive White Italian goose breed from the southern-eastern part of Poland. The flocks ranged from 190 up to over 800 birds kept at different environmental conditions (brick and wooden buildings), while the feeding conditions and maintenance met the general standards for this type of breeding. The farms were provided with permanent veterinary care and the prophylactic programmes included the vaccination against Derzsy`s disease as well as systematic treatment with anthelmintics.

Sampling and isolation of mycotic flora. The scope of the performed investigations contained the assessment of mycotic flora, predominantly the moulds occurring in geese, according to their: flock size, type of farm building, laying season (from 1 to 4 seasons), and the month in the year (January 2003 and 2004, April 2003). Swabs from the beak cavity and cloaca were collected from 10 randomly selected birds from each flock. Totally 920 samples from 460 geese were examined. The collected material was inoculated on a solid Sabouraud medium supplemented with chloramphenicol and incubated together at 25^{o}C and 37^{o}C for about 14 d.

Identification of fungi. Identification of the obtained cultures, according to the traditional mycological methods including microscopic and culturing examinations, was based on the identification key for filamentous fungi after St-Germain and Summerbell (31) and Campbell *et al.* (6). The obtained results were analysed statistically by *t*-Student test with the computer programme Statistica 6.0.

Results

A high level of contamination of the birds with moulds was demonstrated. Out of the 460 examined birds, the fungi were recorded in 335 (72.8%) of them (Fig. 1) and this percentage ranged slightly in relation to the size of the flock, building type, and laying season. In the wooden buildings with a lower stock number as well as in the laying seasons of I and III, the percentage of geese showing the presence of moulds proved to be relatively higher (Figs 1 and 2).

Irrespective of any investigated ontocenosis (beak cavity, cloaca); the fungal flora was similar in respect of species spectrum and a contamination level. Therefore, both factors will be treated together further in this work.

From the sampling material, 19 genera of fungi were isolated and their incidence frequency was highly differentiated (Fig. 3). The following fungi were most often isolated: *Cladosporium* sp. (19.57%), *Acremonium* sp. (18.04%), *Aspergillus* sp. (13.91%), and *Penicillium* sp. (12.83%). *Alternaria* sp. (7.83%), *Paecilomyces* sp. (7.61%), *Mucor* sp. (7.17%), *Scopulariopsis* sp. (6.09%), *Chrysosporium* sp. (5.66%), and *Fusarium* sp. (4.13%) were rarely detected. The other genera of fungi occurred sporadically and their isolation percentage ranged from 3.48% to 0.87% (Fig. 3). The performed studies demonstrated that the isolation frequency of a fungus species depended largely on the maintenance conditions of the birds.

The moulds of *Cladosporium*, *Acremonium,* and *Penicillium* genera, despite explicit quantitative variations, occurred at any conditions in a high percentage of population (Table 1). A correlation between a flock size and number of the isolates was most evident in the case of *Aspergillus* sp., *Scopulariopsis* sp., *Paecilomyces* sp., *Alternaria* sp., and *Chrysosporium* sp. (Fig. 4). In the flocks of over 500 birds, beside a high percentage of *Cladosporium* sp., *Acremonium* sp., and *Penicillium* sp., a clear increase in the incidence frequency of the following fungi was noted: *Alternaria* sp., *Chrysosporium* sp., and *Scedosporium* sp.

On the other hand, the flocks with lower numbers of birds were characterised with an increased level of contamination by *Aspergillus* sp., *Scopulariopsis* sp., and *Scedosporium* sp. (Fig. 4).

The breeding flocks maintained in the wooden buildings showed a distinct increase in the frequency of the following fungus occurrence: *Penicillium* sp., *Scopulariopsis* sp., *Acremonium* sp., *Aspergillus* sp., *Cladosporium* sp., and *Trichosporon* sp., while in the birds from the brick buildings a contamination rise of *Alternaria* sp. was noted (Fig. 5).

The spectrum of fungi microflora composition was also related to the season. In winter, the following species designated in a descending order were found: *Cladosporium* sp., *Acremonium* sp., *Aspergillus* sp., *Alternaria* sp., and *Sporothrix* sp. In spring however, a decrease in the isolation percentage of *Aspergillus* sp., *Acremonium* sp., *Alternaria* sp., and *Cladosporium* sp. was recorded along with an increase in the incidence frequency of *Paecilomyces* sp., *Scopulariopsis* sp., *Scedosporium* sp., *Verticillium* sp., and *Chaetomium* sp. Some new genera like *Pithomyces* sp. and *Beauveria* sp. also appeared (Fig. 6). The statistical analysis of the results compared in Table 2 indicates that irrespective of bird's age (laying season), the species *Cladosporium* sp. and *Acremonium* sp. were the most frequently isolated members of their mycoflora The contribution of the other fungi depended on the laying season.

Aspergillus genus was mainly detected in the birds at the laying period II (20.9%), whereas in other seasons it occurred more rarely and in the IV season it was isolated from 8.5% of samples only. In the II season, the observed contamination peak was produced by *Penicillium* sp. (16.4%), *Acremonium* sp. (19.1%), and *Mucor* sp. (11.8%). The moulds of *Alternaria* sp. and *Paecilomyces* sp. more often appeared in the adult birds (laying season IV), while *Scopulariopsis* sp. and *Cladosporium* sp. were identified in young animals (laying season I).

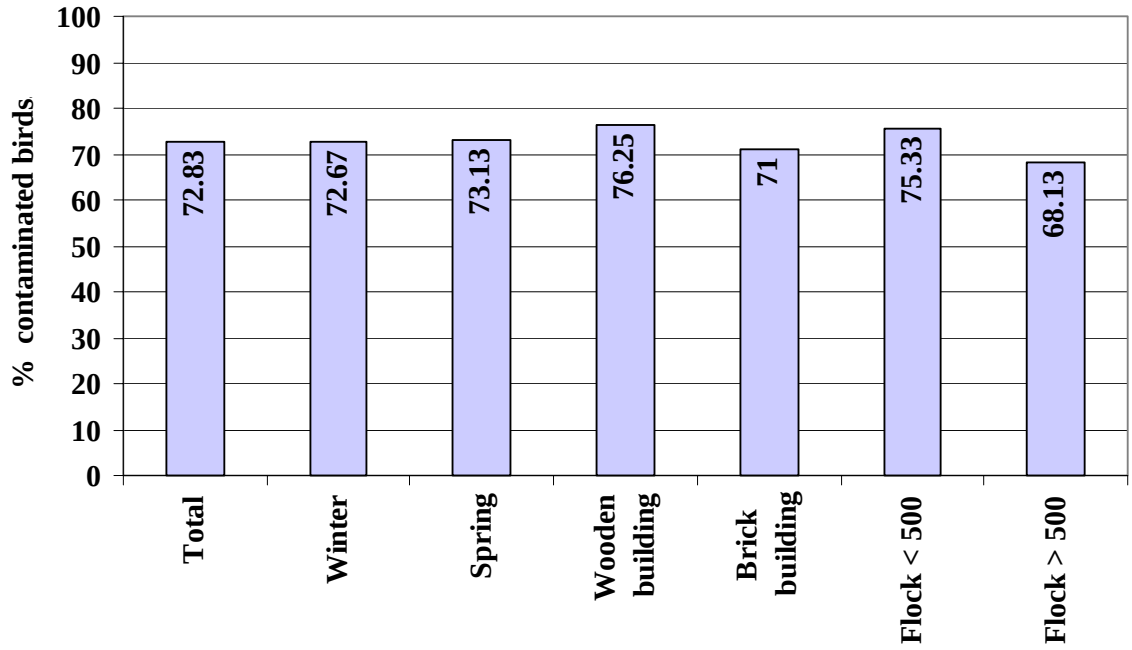

Fig. 1. Moulds isolated from reproductive goose flocks in relation to their living conditions.

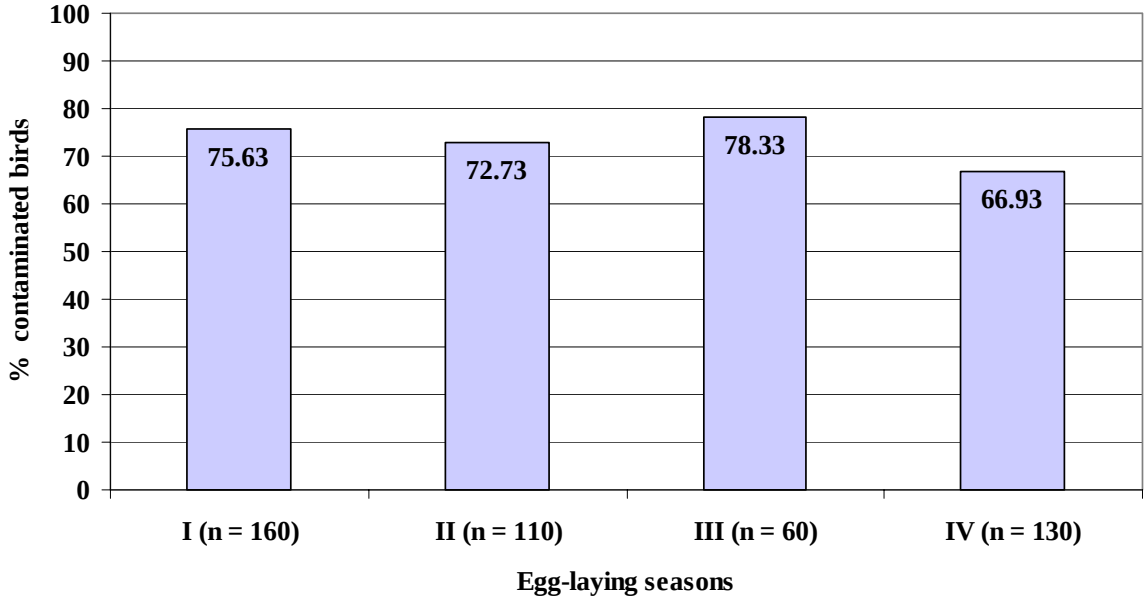

Fig. 2. Moulds isolated in reproductive goose flocks in relation to their age (laying seasons).

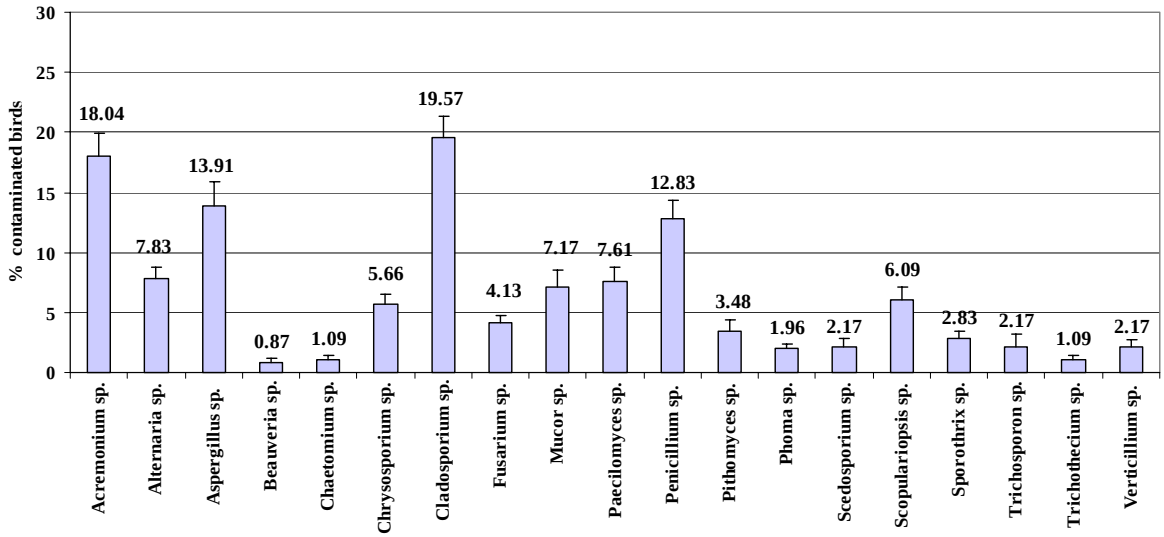

Fig. 3. Moulds isolated from reproductive goose flocks.

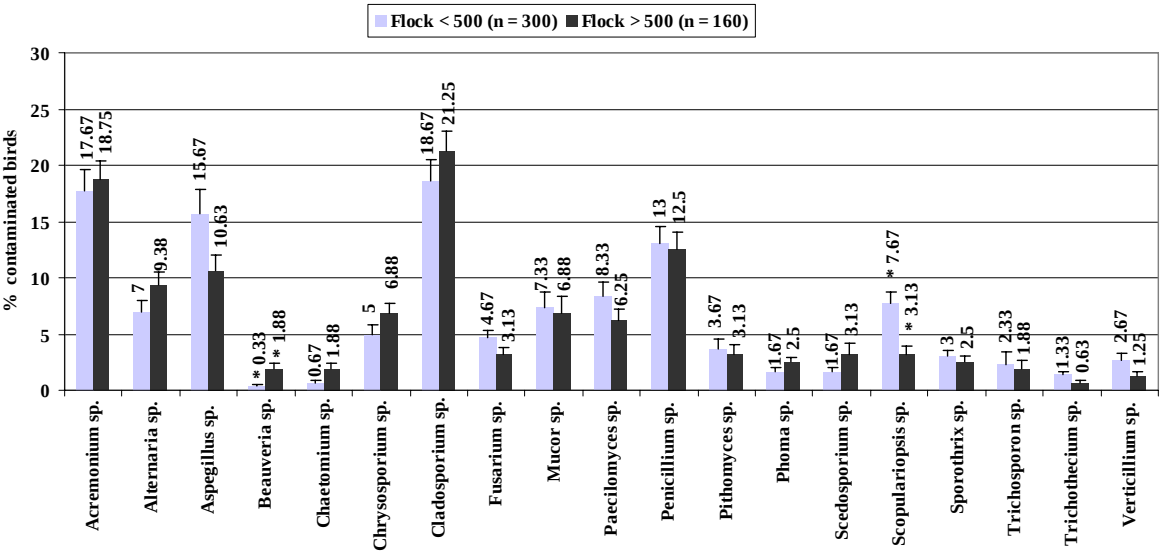

Fig. 4. Moulds isolated from reproductive goose flocks in relation to a flock size.

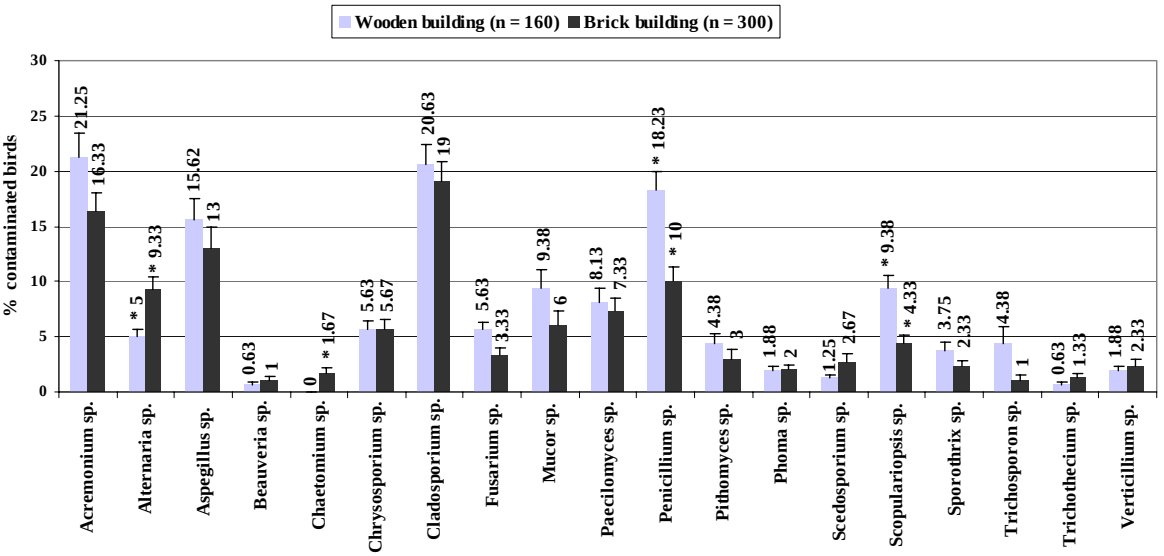

Fig. 5. Moulds isolated from reproductive goose flocks in relation to a building type.

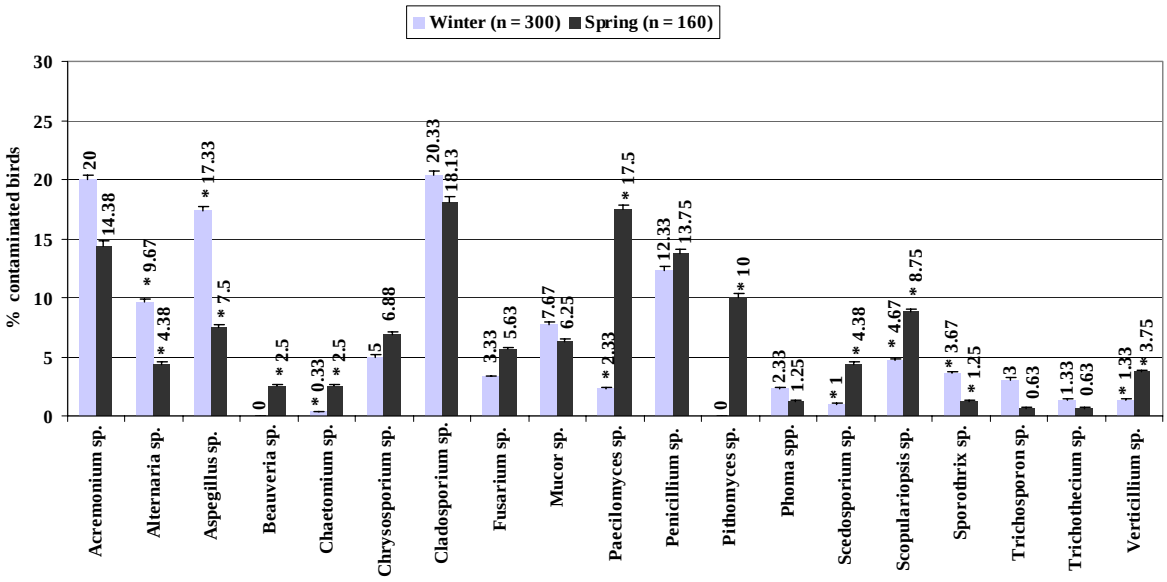

Fig. 6. Moulds isolated from reproductive goose flocks in relation to the season of a year.

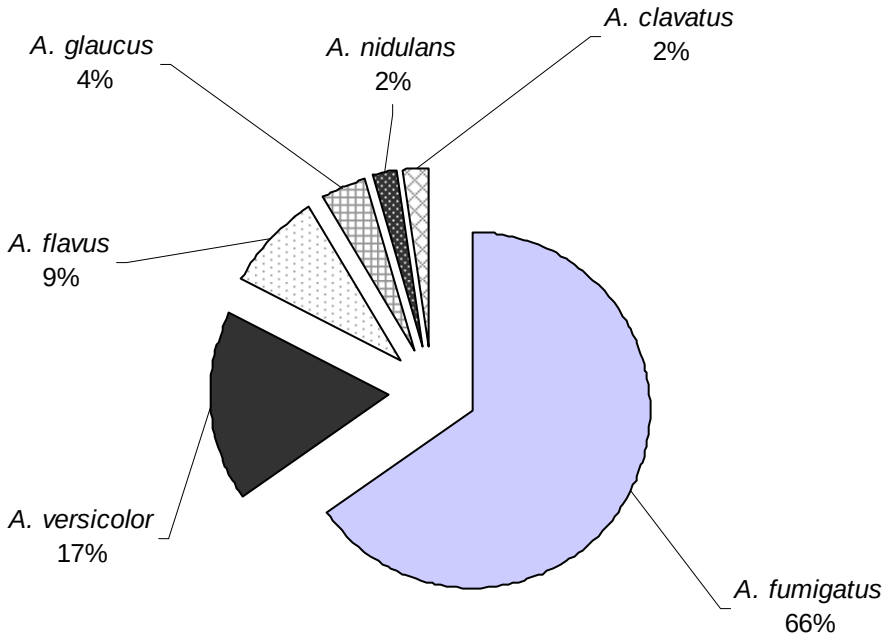

Fig. 7. The presence of *Aspergillus* sp.

Table 1
Qualitative and quantitative differentiation of moulds in reproductive goose flocks depending on their environmental conditions

Mould	Total (n = 460)	Season		Building		Flock number		Wooden building		Brick building	
		Winter (n = 300)	Spring (n = 160)	Wooden (n = 160)	Brick (n = 300)	< 500 (n = 300)	> 500 (n = 160)	Winter (n = 110)	Spring (n = 50)	Winter (n = 190)	Spring (n = 110)
Acremonium sp.	18.04 ± 1.86	20.0 ± 0.33	14.38 ± 0.49	21.25 ± 0.55	16.33 ± 0.31	17.67 ± 0.36	18.75 ± 0.42	2.0 ± 2.14	24.0 ± 2.51	20.0 ± 1.63 *	10.0 ± 1.61 *
Alternaria sp.	7.83 ± 0.99	9.67 ± 0.2 *	4.38 ± 0.16 *	5.0 ± 0.16 *	9.33 ± 0.2 *	7.0 ± 0.17	9.38 ± 0.28	4.55 ± 0.69	6.0 ± 0.55	12.63 ± 1.19 *	3.64 ± 0.67 *
Aspergillus sp.	13.91 ± 1.93	17.33 ± 0.41 *	7.5 ± 0.21 *	15.63 ± 0.47	13.0 ± 0.36	15.67 ± 0.39	10.63 ± 0.35	20.0 ± 2.09 *	6.0 ± 0.89 *	15.79 ± 2.36	8.18 ± 0.87 *
Beauveria sp.	0.87 ± 0.35	0	2.5 ± 0.14	0.63 ± 0.06	1.0 ± 0.07	0.33 ± 0.03 *	1.88 ± 0.14 *	0	2.0 ± 0.45 *	0	2.73 ± 0.67 *
Chaetomium sp.	1.09 ± 0.38	0.33 ± 0.03 *	2.5 ± 0.14 *	0	1.67 ± 0.08 *	0.67 ± 0.04	1.88 ± 0.14	0	0	0.52 ± 0.22	3.64 ± 0.67
Chrysosporium sp.	5.66 ± 0.86	5.0 ± 0.16	6.88 ± 0.22	5.63 ± 0.2	5.67 ± 0.16	5.0 ± 0.16	6.88 ± 0.22	5.45 ± 0.82	6.0 ± 0.89	4.74 ± 0.9	7.27 ± 0.9
Cladosporium sp.	19.57 ± 1.78	20.33 ± 0.34	18.13 ± 0.41	20.63 ± 0.44	19.0 ± 0.33	18.67 ± 0.32	21.25 ± 0.46	22.73 ± 2.1	16.0 ± 0.55	18.95 ± 1.76	19.09 ± 1.97
Fusarium sp.	4.13 ± 0.65	3.33 ± 0.1	5.63 ± 0.2	5.63 ± 0.18	3.33 ± 0.11	4.67 ± 0.11	3.13 ± 0.18	5.45 ± 0.69	6.0 ± 0.89	2.11 ± 0.42	5.45 ± 0.82
Mucor sp.	7.17 ± 1.42	7.67 ± 0.28	6.25 ± 0.3	9.38 ± 0.42	6.0 ± 0.23	7.33 ± 0.25	6.88 ± 0.38	9.09 ± 1.76	10.0 ± 1.73	6.84 ±1.45	4.55 ± 0.93
Paecilomyces sp.	761 ± 1.19	2.33 ± 0.09 *	17.5 ± 0.37 *	8.13 ± 0.31	7.33 ± 0.22	8.33 ± 0.24	6.25 ± 0.24	4.55 ± 0.69 *	16.0 ± 1.82 *	1.05 ± 0.32 *	18.18 ± 1.4 *
Penicillium sp.	12.83 ± 1.5	12.33 ± 0.3	13.75 ± 0.3	18.13 ± 0.43 *	10.0 ± 0.24 *	13.0 ± 0.28	12.5 ± 0.38	19.09 ± 1.87	16.0 ± 1.52	8.42 ± 1.42	12.73 ± 1.1
Pithomyces sp.	3.48 ± 0.89	0	10.0 ± 0.33 *	4.38 ± 0.22	3.0 ± 0.17	3.67 ± 0.17	3.13 ± 0.22	0	14.0 ± 1.14 *	0	8.18 ± 1.4 *
Phoma sp.	1.96 ± 0.4	2.33 ± 0.08	1.25 ± 0.08	1.88 ± 0.1	2.0 ± 0.07	1.67 ± 0.07	2.5 ± 0.11	2.73 ± 0.47	0	2.11 ± 0.42	1.82 ± 0.4
Scedosporium sp.	2.17 ± 0.66	1.0 ± 0.06 *	4.38 ± 0.26 *	1.25 ± 0.08	2.67 ± 0.14	1.67 ± 0.07	3.13 ± 0.25	1.82 ± 0.4	0	0.53 ± 0.23 *	6.36 ± 1.21 *
Scopulariopsis sp.	6.09 ± 0.99	4.67 ± 0.18 *	8.75 ± 0.26 *	9.38 ± 0.29 *	4.33 ± 0.16 *	7.67 ± 0.19 *	3.13 ± 0.2 *	7.27 ± 1.01	14.0 ± 1.52	3.16 ± 0.95	6.36 ± 0.67
Sporothrix sp.	2.83 ± 0.58	3.67 ± 0.12 *	1.25 ± 0.08 *	3.75 ± 0.18	2.33 ± 0.09	3.0 ± 0.11	2.5 ± 0.14	4.55 ± 0.82	2.0 ± 0.45	3.16 ± 0.58	0.91 ± 0.3
Trichosporon sp.	2.17 ± 0.98	3.0 ± 0.22	0.63 ± 0.06	4.38 ± 0.38	1.0 ± 0.1	2.33 ± 0.2	1.88 ± 0.19	5.45 ± 1.81	2.0 ± 0.45	1.58 ± 0.69	0
Trichothecium sp.	1.09 ± 0.31	1.33 ± 0.06	0.63 ± 0.06	0.63 ± 0.06	1.33 ± 0.06	1.33 ± 0.06	0.63 ± 0.06	0.91 ± 0.3	0	1.58 ± 0.37	0.91 ± 0.3
Verticillium sp.	2.17 ± 0.51	1.33 ± 0.08 *	3.75 ± 0.15 *	1.88 ± 0.1	2.33 ± 0.1	2.67 ± 0.11	1.25 ± 0.08	0	6.0 ± 0.55 *	2.11 ± 0.54	2.73 ± 0.65

Data are presented as mean percentage; ± SD; * $P \leq 0.05$.

Table 2
Qualitative and quantitative differentiation of filamentous fungi in reproductive goose flocks depending on their laying season

Mould	Total (n = 460)	Laying seasons			
		I (n = 160)	II (n = 110)	III (n = 60)	IV (n = 130)
Acremonium sp.	18.04 ± 1.86	17.50 ± 1.69	19.09 ± 2.17	15.00 ± 1.64	19.23 ± 2.06
Alternaria sp.	7.83 ± 0.99	7.50 ± 0.68	7.27 ± 1.42	5.00 ± 0.84	10.00 ± 1.00 ***
Aspergillus sp.	13.91 ± 1.93	15.00 ± 2.03	20.91 ± 2.70 ***	10.00 ± 1.26	8.46 ± 1.07
Beauveria sp.	0.87 ± 0.35	2.50 ± 0.58	0	0	0
Chaetomium sp.	1.09 ± 0.38	1.25 ± 0.34	0.91 ± 0.30	0	1.54 ± 0.55
Chrysosporium sp.	5.66 ± 0.86	6.87 ± 0.87	2.73 ± 0.90	5.00 ± 0.55	6.92 ± 0.95
Cladosporium sp.	19.57 ± 1.78	24.37 ± 1.86	15.45 ± 1.29	20.00 ± 2.45	16.92 ± 1.75
Fusarium sp.	4.13 ± 0.65	2.50 ± 0.45 ***	2.73 ± 0.47 ***	6.67 ± 0.82	6.15 ± 0.87
Mucor sp.	7.17 ± 1.42	8.75 ± 1.54	11.82 ± 1.78	10.00 ± 1.09	0 * ** ***
Paecilomyces sp.	7.61 ± 1.19	10.62 ± 1.57 ** ***	0.91 ± 0.30	1.67 ± 0.41	12.31 ± 1.09 ** ***
Penicillium sp.	12.83 ± 1.5	15.62 ± 1.63	16.36 ± 1.96	15.00 ±1.05	5.38 ± 0.78 * ** ***
Pithomyces sp.	3.48 ± 0.89	4.37 ± 1.03	0	5.00 ± 0.84 **	0 ***
Phoma sp.	1.96 ± 0.4	1.25 ± 0.34	3.64 ± 0.50	1.67 ± 0.41	1.54 ± 0.38
Scedosporium sp.	2.17 ± 0.66	1.25 ± 0.34	0	1.67 ± 0.41 **	5.38 ± 1.13 **
Scopulariopsis sp.	6.09 ± 0.99	9.37 ± 1.18 ***	4.55 ± 0.69 ***	1.67 ± 0.41	5.38 ± 1.13
Sporothrix sp.	2.83 ± 0.58	2.50 ± 0.58 **	7.27 ± 0.79 ***	1.67 ± 0.41	0 ***
Trichosporon sp.	2.17 ± 0.98	0	8.18 ± 1.94	0	0.77 ± 0.28
Trichothecium sp.	1.09 ± 0.31	1.25 ± 0.34	1.81 ± 0.40	1.67 ± 0.41	0 ** ***
Verticillium sp.	2.17 ± 0.51	3.12 ± 0.60	0	5.00 ± 0.84 **	1.54 ± 0.38 ***

The data is presented as a mean percentage; ± SD;* P≤0.05 versus laying season I;** P≤0.05 versus laying season II;*** P≤0.05 versus laying season III.

With regard to substantial health hazards posed to the flocks by *Aspergillus* genus, it was determined as a species spectrum of this genus (Fig. 7). It was proved that among 6 determined species the dominant was *A. fumigatus* (66%), *A. versicolor* (17%), and *A. flavus* (9%). *A. glaucus*, *A. nidulans,* and *A. clavatus* occurred sporadically and their isolation percentage ranged from 2 up to 4% (Fig. 7).

The collective data describing a bird contamination level produced by each fungus genus in relation to their environment conditions are given in Table 1.

Among 8 fungus genera recorded most frequently in the monitored ontocenoses of the goose flocks, *Aspergillus* appears more often in the smaller sized flocks, *i.e.* under 500 birds in winter, in the wooden buildings, whereas the presence of *Paecilomyces* sp. was detected mainly in spring, irrespective of the breeding conditions (Table 1). *Scopulariopsis* sp. intensified its presence in spring in small flocks kept in the wooden buildings. *Alternaria* sp.; however, dominated in winter in the brick buildings (Fig. 1). A thorough analysis of the presented results implies a modulating impact of a season in the year, the type of a breeding building, along with the bird's age (laying season) on the qualitative composition of the fungal flora colonising the organisms of the investigated birds. The flock size according to the obtained data had a lesser influence on the genus spectrum of the fungal agents of contamination.

Discussion

The present studies provided the grounds to elaborate the first report on the moulds occurrence in the ontocenoses of the beak cavity and the cloaca of reproductive geese. A lack of similar examinations seriously impedes the comparison and evaluation of the obtained results. Very few works available on these

problems mainly refer to the isolation of yeast-like fungi from the cloaca of carrier pigeons (20), parrots (22), and migratory birds (5).

Monitoring the 17 reproductive breeder goose flocks from the eastern-southern region of Poland, revealed the presence of 19 fungus genera out of which *Aspergillus* sp., *Fusarium* sp., *Paecilomyces* sp., *Trichosporon* sp., and *Scedosporium* sp. are classified as 2nd hazard class (BSL-2) according to the European Confederation of Medical Mycology of 1996. This category includes the fungus species characterised with a relatively high survival rate in the vertebrate's tissues, while in the patients with impaired immunity they may produce deep opportunistic infections (9).

Among the isolated fungi, the most abundant appeared to be the species included into the 1st hazard class (BSL-1), *i.e. Acremonium* sp., *Alternaria* sp., *Beauveria* sp., *Chaetomium* sp., *Cladosporium* sp., *Mucor* sp., *Penicillium* sp., *Verticillium* sp., and *Scopulariopsis* sp. This group generally comprises of saprophytes or plant parasites, and parasites of invertebrates generating coincidental, surface, non-invasive hazards. Still, owing to a fact that opportunistic fungus spectrum posing a potential threat for human and animal health has been still expanding, especially in recent years (27), the above-mentioned classification undergoes the changes as well.

The fungi most dominant in the microflora of the studied reproductive geese, were presented in a descending order of percentage as follows: *Cladosporium* sp., *Acremonium* sp., *Aspergillus* sp., *Penicillium* sp., *Alternaria* sp., *Paecilomyces* sp., *Mucor* sp., and *Scopulariopsis* sp. Due to animal and human susceptibility to an infection generated by *Aspergillus* sp., special attention was drawn to the fungi of this genus. It was found that *A. fumigatus* was dominant (66%) and from the other species *A. versicolor* (17%) and *A. flavus* (9%) were isolated, while *A. glaucus*, *A. nidulans,* and *A. clavatus* occurred in only a few cases. These fungi showed high intensification in winter that was also confirmed by the research results of other authors (14, 15). They demonstrated that the spore content percentage of *A. fumigatus* was 2 - 3 times higher in winter in breeding house air and as high as 8 times in the lungs of the examined turkeys (14). It may be assumed that an increase in bioaerosol content in the birds environment, constitutes the fundamental reason of this effect as it is recorded in winter, when the birds stay in a closed space where the temperature and moisture are elevated and ventilation poor (24, 29). These conditions are conducive to the proliferation of the saprophytic species of fungi, among others *A. fumigatus*, whose spores make a significant percentage of microbes as well as fragments of fungi and toxins detected in the air (1, 11, 16, 17). *A. fumigatus* – the most frequent constituent of a mycotic bioaerosol (8, 34) demonstrating the highest virulence out of *Aspergillus* species and is responsible for *circa* 90% of infections produced by this fungi species (18), and is also reported to show a few traits facilitating the colonisation of a host organism, that is the first stage of infection. It was revealed that conidia of *A. fumigatus* are surrounded with a layer of so-called hydrophobines – proteins of a hydrophobic character that facilitate the spread of spores in air in the form of aerosol (26). Due to a small diameter of conidia (~ 2 μm) they can reach the alveoli (18), while their relatively high thermotolerance (even up to 75°C) allows the fungus to survive and proliferate in a bird organism. Some other species of *Aspergillus* have their growth impeded under these conditions (32).

The other species of *Aspergillus* sp. induce the disease process much rarely. Infections produced by *A. flavus* and *A. niger* were reported sporadically among others in flocks of turkeys, geese, and chickens (2, 3, 25, 30). Similarly in humans, especially in immunocompromised patients, there was observed invasive form of aspergillosis, predominantly developed by *A. fumigatus*, then *A. flavus*, *A. niger,* and *A. terreus* (12, 13, 19).

A potential hazard posed by other species of the opportunistic or saprophytic fungi occurring in the investigated reproductive goose flocks is difficult to assess because of a lack of data. What has been shown so far, is that only *Zygomycetes* can develop a disseminated infection in ostriches, ducks, chickens, and penguins, commonly associated with the blood vessels invasion (23). Besides, *Zygomycetes* may be concomitant to a lung form of aspergillosis as it was confirmed in chickens and parrots (7, 33).

The intensive studies in this field conducted on humans demonstrated that the patients suffering from AIDS and malignant diseases, subjected to immunosuppressive therapy, being after organ and marrow transplantation or severe surgical procedures, old-aged or neonates belong to a so-called risk group. They are affected with very severe life-threatening infections produced among others by *Acremonium* sp., *Fusarium* sp., *Scedosporium* sp., *Paecilomyces* sp., and *Alternaria* sp. (27, 35). Such infections, in particular invasive mycosis are characterised by low susceptibility to the applied drugs, even the newest antifungal agents. Consequently, they cause a high mortality rate (28).

Summing up, it should be emphasised that the presence of a broad spectrum of saprophytic as well as opportunistic fungi in the otocenoses of reproductive geese is alarming. Despite a fact that currently the moulds, apart from *Aspergillus* sp. and rarely detected *Zygomycetes*, do not show a conversion into the pathogenic form in birds, yet on the analogy of humans, it seems to be just a question of time. Therefore, from preventive considerations applying the antifungal disinfecting preparations is intentional in the environment where birds stay.

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