Results

The dry matter (DM) losses in the upper layer showed high values in the control silage. However, the silage covered with polyethylene film achieved more losses than the OB film silages. The moulds counts were higher in polyethylene control silage than in the OB film control silage. We understanding that more moulds create a higher amount of DM losses in polyethylene control silages. In this way, the temperature of silage above the environmental pattern showed high values in polyethylene control silage and this fact contributed to increased competition across fungi strains and to a higher aflatoxin production. The use of additives showed less DM losses in polyethylene film, but in the silage covered with OB film the benefits of additives were not observed due to a better control of losses.

Table 1 *Corn silage fermentation variables according the sealing methods*

	Polyethylene film			OB film			
Item[1]	Control	Bacterial	Chemical	Control	Bacterial	Chemical	SEM[2]
DM losses, %	13.18^{a}	6.82^{b}	7.23^{b}	9.73^{ab}	8.41^{ab}	8.54^{ab}	0.65
Molds (log_{10} cfu g^{-1})	4.11^{a}	2.95^{ab}	3.35^{ab}	1.41^{b}	3.31^{ab}	3.40^{ab}	0.28
T-E, °C	2.93^{b}	4.83^{a}	3.76^{ab}	0.79^{c}	2.35^{b}	1.55^{bc}	0.39
Aflatoxin (ppb)	13.02	nd	nd	nd	nd	nd	–

[1] DM = dry matter; cfu = colony forming units; T-E = temperature of silage above of environment; nd = not determined; [2]SEM = standard error mean.

Conclusions

The use of oxygen barrier plastic film to cover corn silage led to lower temperature patterns in the upper layer of the silo which inhibited the growth and aflatoxin production. However, no response was observed on the control of DM losses.

Acknowledgements

The authors would like to thank FAPESP (São Paulo Research Foundation) for the support in this project.

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doi:10.1017/S2040470010000920

Heavy metals contents in farrowing, weaning and fattening pig feeds in a commercial pig farm in Beijing and their thresholds values given by the Chinese feed standards

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Introduction

Formulation of pig diets follows local recommendations in order to achieve efficiency in terms of productivity, food safety, environmental protection and welfare in pigs. Nutritional requirements for pigs vary in every growing stage and are taken into consideration when

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formulating pig ratios. Mineral additions in current pig diets differ from the established standards. Literature about the composition of the pig diets in each growing stage is not broadly available. This study presents the main contents of heavy metals found in pig feeds from a commercial farm in Beijing and compares the results with the existing Chinese recommendations.

Material and methods

Following the pig growing stage i.e., farrowing, weaning and fattening, a total of 21 samples of pig feed were collected during June–July, 2009 at a commercial pig farm in Beijing. The feed samples were analysed in the State Institute of Agricultural Chemistry of the University of Hohenheim, Germany. Chinese Standards such as the GB 13078-2001 "Hygienical Standard for feeds" that state the allowed amounts of feed additives, harmful substances and micro-organisms during the chemical testing and, the GB 8471-87 "Feeding Standard for lean-type pigs" that cover the desirable feed compounds and concentrations for pig diets that apply to feed factories, pig farms and specialized households were used in order to compare the results obtained in this study with the thresholds recommended in China.

Results

Zn concentrations showed the largest variation between feed samples. Farrowing piglets' feed samples had the highest Zn mean values, 1520 mg/kg. In effect, Zn contents were found to be 10 times more than the recommended Standard. The highest mean values of Cu and Mn were found in the weaner feeds, 240 mg/kg and 111 mg/kg respectively, while the lowest mean values of Cu and Mn were found in the farrowing piglets' feeds, 125 mg/kg and 68 mg/kg respectively. Heavy metals contents of Zn, Cu and Mn in the pig feeds surpassed the recommended values given by the Chinese Standards. These results reflected the abuse of mineral supplementation in pig feeds that is common practice due to their stimulating effects on pig growth performance. Pb, Cr and Cd were found to be less than the recommended thresholds. As and Hg were not analyzed in this study, though they are presented as reference for further research. The concentrations of heavy metals in the pig feed samples can be ranked in the following order: Zn > Cu > Mn > Cr > Pb > Cd; similar to the ranking found in the pig manures from the same pig farm (results to be published). High contents of heavy metals in the pig feeds might also be a result of the unbalanced formulation of the pig rations. Pig feeds for farrowing piglets, weaners and fatteners are mainly constituted by corn, soybean meal, fish powder, bran, oil and premix. It should be noted that Zn, Cu and Mn thresholds values were extracted from the GB 8471-87 Chinese National Standard, given in 1987 which means these values are not up to date. This Standard is still used for pig rations formulations in large pig farms in China which throws into question the current scientific background of the existing standard.

Table 1 *Values of heavy metals found in Farrowing, Weaning and Fattening pig feeds (mg/kg final compounded diet)*

Item	Standard Pig: 1–5 kg	This study Farrowing piglet	Standard Pig: 10–20 kg	This study Weaning pig	Standard Pig: 20–60 kg	This study Fattening pig
Zinc (Zn), mg^{+}	110	1520	78	1497.14	110	186.86
Copper (Cu), mg^{+}	6,50	125	4,90	240.29	4,36	192.71
Manganese (Mn), mg^{+}	4,50	68	3,00	111.20	2,18	93.23
Arsenic (As), mg*	⩽2	na	⩽2	na	⩽2	na
Lead (Pb), mg*	⩽5	0.00	⩽5	0.16	⩽5	0.20
Chromium (Cr), mg*	⩽10	0.67	⩽10	1.30	⩽10	0.81
Mercury (Hg), mg*	⩽0.1	na	⩽0.1	na	⩽0.1	na
Cadmium (Cd), mg*	⩽0.5	0.12	⩽0.5	0.09	⩽0.5	0.00

$^{+}$: extracted from GB 8471-87, *: extracted from GB 13078-2001, na: not analyzed, -: value not available.

Conclusions

Major heavy metals such as Pb, Cr and Cd were found to be within the recommended range for pig diets. Zn, Mn and Cu surpassed the thresholds established in the Chinese Standards. The highest heavy metals contents were found in the weaner feed samples which might be due to the high safety ranges used in the Beijing pig farm in order to achieve higher productivity ratios.

Acknowledgement

The authors gratefully acknowledge the support of the International Research Training Group of the University of Hohenheim, the China Agricultural University funded by the German Research Foundation (GRK 1070) and the Ministry of Education (MOE) of the People's Republic of China.

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https://doi.org/10.1017/S2040470010000920 Published online by Cambridge University Press