Rožnovský, J., Litschmann, T. (ed): „Bioklimatologie současnosti a budoucnosti“, Křtiny 12. – 14.9.2005, ISBN 80-86 690–31-08

CLIMATICAL FACTORS AND THEIR EFFECT ON PRODUCTION IN ANIMAL HOUSING

J. ŠOTTNÍK

Summary:

Climatical factors have important influence in animal housing on productivity of some different species, different courses and physiological reaction of the organisms. Important are keeping in stables, or housing areas with the general -valid standard and their given as are - temperature, relative humidity, air moving- air speed in our continental climate. Influence of climate parameter have increasing on importance if coming climate change, especially if coming extremely weather in summer and in winter period must be in prescribed state. In this state is necessary regional modification courses extreme higher temperature and, low relative humidity and low air moving in place of the animals staysplace of abode. In life areas must be complete climate parameters hold in comfort zones as welfare parameters. From this point of view is actually and necessary technically reducing the extreme climate condition in stable - especially negative influence of the higher air temperature, low humidity and air moving. Important is good solving building construction, their thermo-insulation properties, and technically processing of the air cooling with know technique evaporation-or technology air fogging and reduction with higher air moving in staying place of housed animals. If are not respected these recommendation for reduction animal extremely climate environment, come reduction efficiency using ME in food or production and health problems as animal mortality i.e. chicken broilers at finishing fattening period etc. If are not good air quality are problems with health are increased, therefore are necessary to secure improving ventilating systems and their operation regime.

Keywords: climate factors, animal housing, animal production and health

INTRODUCTION

Modern animal housing systems have more factors which are necessary to be respected if animal housing is to be economically effective. Today must be respected more principles at planning housing systems with mechanised or automatically technological line with low labour necessity, at respecting welfare requirements of housed animals of different species, and respecting requirements on environment protection too. Those opposite requirements on housing conditions and technology and multifactorial function is not possible optimised without investment means. Some criteria are opposite as welfare and economically housing systems. Their relationship is in mutual, opposite triangle functioning. For the different animal housing systems are necessary to put on different amount of energy which depends or is developed from animal requirements on thermal comfort with respecting thermo-neutral -heat zones and from good thermal insulation of the building of stables, their construction elements. Different requirements on climate parameters for some animals are discussed in this paper.

PROBLEMS AND DISCUSSION

Some different farm animal species need more differentiated thermal–temperature and other microclimate parameters t_{db} (°C), RH (%), K ($W.m^{-2}$), v ($m.s^{-1}$); (CO_2), (NH_3, H_2S). The technological and building solution is more important as basically for developing and planning from point of view of creation and optimisation stable microclimate and housing systems too.

CATTLE HOUSING

Development of cattle rearing or housing systems in our country had more stages, this was oriented on rational solution and housing conditions. They depended from economical and practical possibilities of realized research or scientific knowledge. At present must be in the new oriented animal housing respected ethology and animal welfare and environment protection with

Ing. J. Šottník, Research Institute of Animal Production & Institute of the Breeding Technology of Animals and Ecology, Hlohovská 2, 949 92 Nitra, Slovakia, e-mail:sottnik@vuzv.sk

basic requirement on economical production of milk and meat. This elementary orientation on new housing systems is not simple to be realized in practical conditions with all requirements counterbalanced without possibility to invest for reconstruction and new construction of stables.

Not long ago housing systems and their realization were oriented towards higher concentrations and higher capacity of animals in stables. Realized were more housing systems without litters as to spare labour or time-work. Requirements of animals for ethology or welfare and ecological utilization of animal manure were not respected, environmental balance was not settled. Application of technique and insufficient storage capacity (three months) for slurry were not satisfactory and it was not sufficient for regularly applications. These solutions were so-called industrial rearing or housings systems, and these solutions were advantageous in saving investments on LU–livestock unit (for animal) at relative completely technological and building solutions at specialized farms. Exact housing conditions were not at all in harmony with standard requirements of animals. Preferred were more saving means, and/or doctrine about “advantageous” systems with higher animal concentrations in one building indoors (building block- stable). These systems required exact rearing conditions which were not all time realized.

In this time were realized experimentally, and partly later on also in widest practical application conditions non and partially insulated stables for heifers and fattening bulls with litter or without litter. Savings were realized on built solutions at two orientation non or saving roof insulations, saving on places (area) for feed intake at trough (feed pass) so more narrow proportion - state, one place for two or three animals (1:2 or 3). These solutions were not suitable for rearing conditions. Food amount and its quality had effect on animals, on their social behavior activities and from this situation resulted smaller production efficiency. At the same time there were in not insulated or partly insulated so called cold stables insuficiently realized drinking systems at so-called "Feedlots" and in save insulated stable were freezing conditions in winter periods, too (-8 - 15°C), and smaller than were outside winter climactic conditions. In these rearing conditions is necessary better and higher amount of feed for animals according to microclimatical conditions. There were at that time not properly solved water supply in these stables. There are predominant reconstructions of older smaller stables for 100 or 200 animals (LU) in new economical situations. There are proposed and used opened housing systems with best exploited rearing conditions and with better feed and water supply. Natural ventilation systems are in these stables. Calving stables are more and more build as grouping pens and opened - free stables. For good solutions of reconstruction it is necessary to improve technological and rearing systems in older stables and airing systems, too.

PIG HOUSING

At the creation of the microclimate in stables for the pig housing is necessary to respect the temperature and relative humidity described as range of their physiological-production optimum. For achievement this limit standard are right-positive thermo-insulation properties, with which will be able keep stable state with standard microclimate. These parameters are partly prescribed different in various countries.

Some two different climate in sows and piglets housed together in pen and special boxes for piglets–nest. This room must be heated and at our standard must be at some smaller piglets keep on 32 ºC, while for sows is sufficient 22 ºC (22ºC is low critical temperature J. M. Bruce 1981).

Air movement must be without draught of air, their optimisation state are dependent on air temperature, pig categories and is more different in (0.05 to 2 $m.s^{-1}$). Cold radiation must be eliminated in winter periods with thermo-insulation properties. At heat, thermal deficit must be the space equipped with heating systems, especially in birth sections with differentiated temperature zones. It is possible using direct heating systems in pre–fattenig housing, or floor heating act. Ventilation rates are different too as it is necessary for category and climatical period. It must be equipped with effective control systems based on temperature control (Šottník 2001).

Environment of pig stables have great influence not only on the health and welfare of housed animals but also on their parameters of production and reproduction. Stable air quality can impact the feed efficiency. During the low air temperature period in the stable the feed intake increases to correct the thermoregulation. While the high temperature of the stable air eventuate to the decrease of feed intake. Higher ammonia concentrations increase susceptibility of pigs to the respiratory infection. As well the dust particle can stress the respiratory system

Ing. J. Šottník, Research Institute of Animal Production & Institute of the Breeding Technology of Animals and Ecology, Hlohovská 2, 949 92 Nitra, Slovakia, e-mail:sottnik@vuzv.sk

(Novak, P. at all, 2001). The influence of microclimatic factors, e.g. air temperature, relative humidity, air movement, carbon dioxide and ammonium concentration and concentration of micro-organisms were evaluated during all seasons of the year. They proved the high degree of correlation between the deviation of the indoor climate outside the range of optimal values, and the lowered body mass increase during the fattening period. The decrease in body mass growth was joint with higher mortality rate and higher number of emergency slaughtering in the herds. Especially the period of sudden changes in the outdoor climate, heavily influenced the ventilation of stables, and provoked remarkable worsening of the health status in the housed pigs.

In fattening pig are more important temperature and humidity parameters, and air speed is necessary to be observed as more important thermal production factor or efficiency of food consumption and their effective conversion on gain.

POULTRY HOUSING

Poultry are more sensitive organisms, animals which need some precisely prescribed thermal environment–microclimate, and from temperature developed other factors as are relative humidity, air moving, and other parameters, as are carbon dioxide. It is more important for testing of the intensity ventilation systems of the stable; low ammonia, dust and bacteria content in stable air is important from point of view, respiration-health problems in chicken, hens, turkey if are higher ammonia dust and bacteria concentration as is recommended, if are long-term i e. at deep litter, etc. If are not god air quality the problems with health are increasing, therefore it is necessary to secure improvement of ventilating systems and their operation regime. Noxious gases in poultry houses are generated as product of animal metabolism and as animal wastes break down (Gürdil G. at all, 2001). These gases can produce oxygen-deficient, toxic or dangerous atmospheres. The most common noxious gas, which is produced in poultry houses, is ammonia. The effect of this gas can even increase the mortality rate in broiler and laying hen houses where the litter bedding system is used under insufficient ventilation rates in hot climates. This research was carried out in poultry houses of southern part of Turkey where the climatically conditions are very hot during the summer season. The NH_3 concentrations are measured in floor type broiler and laying hen houses and in caged type laying hen houses. The NH_3 gas concentrations in floor type breeding (broiler or laying hen houses) are found to be higher than in the caged type breeding. The effect of indoor air temperature and relative humidity values to the concentration of ammonia inside the poultry houses is examined – described with authors.

BIOCLIMATICAL PROCESSES IN ANIMAL HOUSING AT EXTREME WEATHER CONDITIONS

The animal housing and bioclimatology as processes are functionally dependent on local climate in different regions - our climate is continental climate. Their functional dependence is in systems :

Climate Environment ←→ Animals ←→ Housing Conditions

All processes are derived from physiological and production optimalization of microclimate parameters and their effectiveness kept in different calculations in climatical regions. These climate conditions must be purpose modified. These processes are under economical pressure, or ability of farmers using investment means for modernisation of housing systems in building and technological equipment for improving microclimate, air moving (air speed) and receiving microclimate environment with reduced heat stress conditions. At standard conditions of weather it is necessary to modify in continental course of weather the differences in air temperature-its change during the year 50-60 K (from –20 –25°C–30°C to 30°C (35°C). Requirements are changed if we take the border state and it is - 25°C in winter to +30°C or 35°C in summer, what is possibly indicated as extreme microclimate conditions. Further deviation in course of weather are increasing the requirements for modification of extreme microclimate, which have negative influence on physiological function of animals and their production and possibility of the farm animals to adapt for these conditions, on health or mortality of broilers and so on. Those principles derived from thermoneutrality of animals are valid in summer and winter periods, specified differences are given as optimal zones, which must be kept in economical zones by means of building and technological solutions. If extreme course of weather is over in permit zones or limits reductions are necessary with not typical condition with untraditional equipment (for

Ing. J. Šottník, Research Institute of Animal Production & Institute of the Breeding Technology of Animals and Ecology, Hlohovská 2, 949 92 Nitra, Slovakia, e-mail:sottnik@vuzv.sk

higher air moving–air velocity-aeration ventilation, air fogging cooling).

CONCLUSION

Microlimate parameters are necessary to be considered as important production factors, and their effect on production and health in animal housing were described in paper. Influence insufficient air quality and not respecting microclimate parameters for different species have negative impact on production and health in housed animals too. All processes must be derived from physiological and production optimalization of microclimate parameters and their effectiveness must be calculated in local climate, climatical regions. Extreme summer climate conditions must be purpose modified. These processes are under economical pressure, or ability of farmers using investment means for modernisation of housing systems in building and technological equipment for improving microclimate, as are air moving controled about air temperature. Necessary are receiving microclimate environment with reduced heat stress conditions with air evaporative cooling, or with some different not expensive technique of air modification.

References

Bruce, J. M. 1981, In: Clark, J.A..: Environmental aspect of housing for Animal production, Butterworths, London, 1981, 511 p.

Gürdil, G.A.K., Kic, P., Yildiz, Y., Öner, İ.: The effect of hot climate on concentration of NH_3 in broiler and laying-hens houses, Zborník abstractov z konferencie BKPD 21, BkS - SAV Extrémy prostredia (počasia imitujúce faktory bioklimatologických procesov, Račková dolina 10-12.9.2001(In English)

Novák, P., Odehnal, J., Zabloudil, F., Šoch, M.: Stable environment – important factor influencing the health and welfare of pigs, Zbornik referátov z medzinárodnej konferencie SPU Nitra, Chov ošípaných v 21.storočí, 12-13.9. 2001 (In Czech, Abstract in English)

Šottník, J.: Faktory prostredia pre chov hydiny a možnosti ich stavebno - technického zabezpečenia v modernizáciach chovných objektov, Sborník přednášek 9. medzinárodního symposia Aktuální problémy šlechtení, chovu, zdraví a produkce drůbeže, 10 let Jihočeské university, České Budějovice, 6-7.2.2001, s 59 (In Slovak)

Šottník, J.: Reconstruction and Non and Partially Insulated Stables for Cattle Rearing as Rational Solution and Housing Conditions, In.: Book of Abstracts of the 52nd Annual Meeting of the European Association for Animal Production, Book of Abstract No.7. (2001) Budapest, Hungary, 26-27 August 2001 Cattle Production /C/ Poster C5.9 (In English)

Šottník, J.: Bioklimatologické procesy v chove zvierat za extrémnych podmienok počasia Zborník abstractov z konferencie BKPD 21, BkS - SAV Extrémy prostredia (počasia imitujúce faktory bioklimatologických procesov, Račková dolina 10-12.9.2001(In Slovak**,** Abstract in English)

Šottník, J.: Tvorba mikroklímy v modernizovaných objektoch pre chov ošípaných, Zbornik referátov z medzinárodnej konferencie SPU Nitra, Chov ošípaných v 21.storočí, 12-13.9. 2001, 319-322 (In Slovak, Abstract in English)

Ing. J. Šottník, Research Institute of Animal Production & Institute of the Breeding Technology of Animals and Ecology, Hlohovská 2, 949 92 Nitra, Slovakia, e-mail:sottnik@vuzv.sk