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ON THE OCCASION OF PROFESSOR MVDr. ZDENĚK VĚŽNÍK, DrSc., SEVENTIETH BIRTHDAY ON JUNE 30, 1998

The professional life of professor Věžník has been closely connected to the Institute of Veterinary Medicine. Professor Věžník belonged to the very first employees of the Institute and participated in the drafting of its design. Speaking both literally and metaphorically, we can therefore say that he laid its foundations. Furthermore, throughout all his life, he contributed actively to the institute's numerous activities. This resulted in dozens of completed research projects and thousands of hours of lectures and consultations that shaped hundreds of veterinary experts. Professor Věžník spread among them ideas such as his belief in the principle of a single medicine and a holistic approach toward it. As a consequence of his activities the Institute has acquired a firm methodological basis for veterinary andrology and gynecology. In due time Professor Věžník became a widely respected figure, acknowledged by veterinary physicians (ranging from field practitioners to highly specialized scholars) as well as by physicians dealing with humans. All of his former students, many of whom have in the meantime become his collaborators, value his unusual expertise and team spirit.

Professor Věžník has always felt at home both at the laboratory and in agricultural production, no matter whether he was in the role of an ordinary veterinary doctor, consultant, or the head of a large research team. He always subjected the problems he encountered to a thorough examination, taking his time to arrive at their profound understanding. At the same time he never gave the impression of a preoccupied scholar who actually would like to help but, unfortunately, is unable to, due to lack of time. He has always shared his vast, almost encyclopaedic, expertise, often at the expense of pursuing his own scholarly interests and possibly also his health. Rest was something he almost never knew, although I am sure it would have been well deserved. His attention gets attracted by almost anything only marginally related to his profession, and so the work in the Institute at his department is not entirely sufficient for him. After many years of limited professional opportunity that he suffered from at a time when his scholarly, professional career should have culminated, with the vigor and energy of a person much younger his age, he plunged into a variety of research and management activities not only

in his own Department of Reproduction but also in the Institute at large, trying to redefine its position in the current social situation – one that is not entirely favorable to research activities. However, the wide array of Professor Věžník's activities is not exhausted by this. He participated in the establishing of the Chamber of Veterinarians of the Czech Republic, a professional organization that he presided over in 1990–1991, as well as in the restructuring of the Czech Academy of Agricultural Sciences, where he currently serves his second term as president of the Section of Veterinary Medicine, while at the same time being a member of the board. Professor Věžník is also active in the realm of teaching, he is a member of the subject committee for post-graduate studies and the scientific board of the Faculty of Veterinary Medicine. He is also a member of a number of examination, habilitation and appointing committees, and reader of research reports, habilitation works and manuscripts of papers due to be published in Czech or foreign journals. Since 1990 our own journal has benefited from Professor Věžník's activities in its editorial board, due to his support of changes aiming at an increased rigidity of result assessment prior to publication. This contributed to an improvement that has been much appreciated both by scholars in the field and by independent referees.

Not even such a heavy scholarly and paedagogical load fully exhausts Professor Věžník's range of activity. He also finds time to pursue his life-long devotion to horses: he belongs to the scientific board of the Kladruby stud-farm as well as to numerous other veterinary and breeding advisory bodies. In addition, he is the president of the horse-riding club „Moravan“ and sometimes acts as a riding instructor for children.

I assume, that all these activities would, particularly in today's harsh economic climate, totally exhaust even a healthy young man working full-time. This leads me to the conclusion that Professor Věžník has not disclosed all his findings and – being as modest as he is – he still withholds from us the secret of the elixir of life and eternal youth. Let us wish, therefore, that he keeps enjoying its benefits for a long time to come. Let us wish to him that beside finding constant pleasure at the sight of the significant body of work he has created so far, he also keeps enjoying the harmonious family relationships he is surrounded by.

Prof. MVDr. Karel Hruška, CSc.

THE PLANET EARTH IN JEOPARDY AND SMIDAK PRINCIPLES

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Motto:

"A significant biological species is in jeopardy due to a continuing damage to the environment. This species is man".

Fidel Castro at the Summit in Rio de Janeiro, 1992

The Summit Earth, held in Rio de Janeiro in 1992 and attended by 15,000 delegates of 178 countries, 115 heads of states and prime ministers, and representatives of more than 1,400 institutions, has been the largest gathering in the history of diplomacy. It would appear that mankind is becoming aware of the urgency of coping with the principal ecological problems of the planet Earth jeopardizing all life on it.

Six years have elapsed since the plenary session in Rio. What has happened with the best objects and intentions proclaimed at the summit? Which of them have been materialized? In a review of the fate of conclusions arrived at the summit, published in July 1997, UNO had to state that even the richest countries lacked both money and political goodwill to at least slow down global deterioration of the environment. Social problems and environmental protection have been disregarded by responsible politicians and the resolutions of Rio have not been materialized.

The document "Summit Earth + 5", submitted to the 1997 UNO plenary session, states:

The world's population has grown again. The state of the environment has deteriorated again. Approx. 1.5 million of people must manage on 1 dollar per day. More than 50 percent of the world's population are undernourished.

Approximately 10 million people had lived on our planet in the 7th millennium B.C. By 1950, i.e. within 8,950 years, the population grew to 2,500 millions and during the period 1950–1987, i.e. within 37 years, to 5,000 millions. The current growth of population is 3 persons per second or 250,000 persons per day.

In Rio, developed countries promised to support developing countries with 0.7% of their gross national products. In fact, this support has been reduced to 0.27% – the lowest value since World War II.

The extinction of biological species continues.

Plant and animal species are repressed by extraction of raw materials, urbanization and intensification of agriculture.

Fifty to one hundred plant species become extinct every day. Should this tendency continue then one quarter of the existing species will disappear forever within 20 to 50 years. Twenty to thirty animal species live on every plant variety.

The total amount of carbon dioxide is increasing. A climatic catastrophe is now more probable than it was five years ago.

Carbon dioxide is the major atmospheric component participating in the rise of the greenhouse effect a phenomenon with a considerable impact on global climate, sea levels and world agriculture. The amount emitted into the atmosphere increased from 14,640 million tons in 1970 to 18,792 million tons in 1980 and to 21,562 million tons in 1990. Road transport also contributes to global warming of the atmosphere: the world car production rose from 9 millions in 1960 to 35 millions in 1985, i.e. to a fourfold.

The emission of freons onto the atmosphere continues.

The total marine catch is increasing.

According to an FAO report, fish as a foodstuff will become extremely scarce in the coming 15 years if the over-fishing of the oceans continues. The amount of processed fish reached 101.3 million tons in 1993.

Surface and ground water reserves have been exhausted. Desert areas are extending. The supply of drinking water is under long-term threat.

Drinking water reserves are menaced world-wide because the pollution of ground water by fertilizers, sewage and industrial chemicals is increasing. According to WHO estimates for developing countries, 3.2 million babies and children die annually of waterborne diarrhoeic disease and more than 2,000 million people are menaced by waterborne infections. Rivers and lakes contain various pollutants, such as heavy metals, mercury, chemicals and cancerogens.

A UNO declaration was issued on the occasion of the 1st International Day Against Extension of Deserts. The extension of deserts threatens the existence of more than 1,000 million people. During the last 20 years, the advancing aridization resulted in a loss of an area of arable land, corresponding to the whole territory of the United States.

Clearing of rain forests is going on at a rate of an area corresponding to two football grounds per second.

The mineral wealth of the world disappears without restraint. Mineral reserves are not inexhaustible, but their extraction accelerates due to population growth and increasing demands on a higher standard of life.

Increased extraction rate is associated with the generation of municipal waste.

It can be expected that governments will concentrate rather on local and national problems and neglect global long-term activities.

The vice-president of Doro Chemicals Mr. Claude Tussler said: "The future of the world will be determined by companies with global ranges of activities, autonomous authorities and citizens' incentives; the opinions of top politicians will become irrelevant."

An analysis of the above phenomena and events leads to a conclusion that they share a cause that could be called "extinction of positive spiritual potential" of mankind. This is a factor distinguishing man from animals and a factor that can ensure permanent coexistence of man with all other forms of life of this planet. "Ecological crisis", which has acquired a "global character", is not but a consequence of the "crisis of humanity".

The economic development of the human civilization depends on drawing of natural material and energetic resources. This statement pertains not only to raw materials, but also to the capacity of processing of various wastes and to the sustaining of the principal life-giving systems including soil, water and air as the only ones that are capable of ensuring the survival of the biosphere.

Technology has got ahead of science in such a way that consequences of the technological progress have become unpredictable. Results of scientific and technological activities are involved in the tangle of causes and unpredictable consequences affecting people, societies and populations.

Man has refused the responsibility for his deeds. This refusal has affected his attitude to nature and has become the principal cause of the ecological crisis.

Sooner or later, the global system will collapse. None of the international agreements aimed at the prevention of this collapse were effective enough and objectives of the world-wide programme "World Strategy of Nature Protection", proclaimed in 1980, or the current concept of "permanently sustainable development" have not been achieved. Any regeneration efforts must be based on the concept of life in which technology and humanities are no more adversaries, but rather complete each other to renew the role of man as a positive element of biosphere and not to degrade him to a destructive parasite.

These rather complex problems are coped with also by F. E. Smidak – a Swedish citizen of Czech origin, President of Swiss Foundation for Research of Human

Society – who has drawn up the following two principles:

The first principle is POWER AND RESPONSIBILITY. The second principle is ACTION AND RE-ACTION.

The term Power is defined as the capacity to control man, the environment and conditions.

The term Responsibility is defined as the awareness of consequences of exertion of power.

No one should be entrusted with more power than responsibility and no one should have more responsibility than power. Power should be exerted only by those, who are capable of assuming responsibility for their deeds. Only those should exert power who can bear the responsibility for doing so. Anyone who exerts power without responsibility is acting wrongly.

The term Action means something that is done, including measurable and immeasurable activities.

The term Re-Action means a response or consequence.

It is essential that the principle Power and Responsibility is always applied together with the principle Action and Re-Action.

Each chapter of Smidak's book "J'accuse" is closed with a question how are the principles Action and Re-Action and Power and Responsibility applied in environmental policy.

Considerations on Smidak's postulates lead to a conclusion that the role of individuals in the protection of the environment is irreplaceable and that the future of Earth will be decided on by pushing individuals and groups that should be without doubt guided by scientists. Each of them will be expected to do his best to elaborate within the range of his activity a specific concept of systemic global changes aimed at the protection and improvement of the environment.

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CHRONIC STRESS AND ITS IMPACT ON REPRODUCTIVE FUNCTIONS

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Human activities have impaired the ecological balance to such an extent that nature will not be able to provide conditions necessary for sound development unless they are effectively controlled in time. Serious interventions of man into the environment have brought about global effects. The European Economic Commission has defined the environment as an aggregate of objects, conditions and effects that surround live organisms and influence their development.

To generalize this interaction, the three major entities can be defined as man or animal (individual), ecosystem and life style or herd management practice, and presented in the form of three partly superimposed circles. The conjunction areas imply the intensity of interaction and can be used for the interpretation of results of causal analyses. Shifts of the circles along the lines connecting their centres result in changes of the conjunction areas thus expressing changes in the intensity of interaction. A shift of the circle representing individuals demonstrates the role of constitution expressed here in terms of the function of defence mechanisms or adaptation ability.

It has been documented in a large number of papers that the maintenance of regular reproductive functions in high-performance animals exposed to adverse factors of the environment and internal milieu and effects inducing chronic stress is a rather difficult task. The current herd management systems as formed by civilization factors, are clogged with a large number of factors inducing acute or chronic stress in both female and male breeder animals.

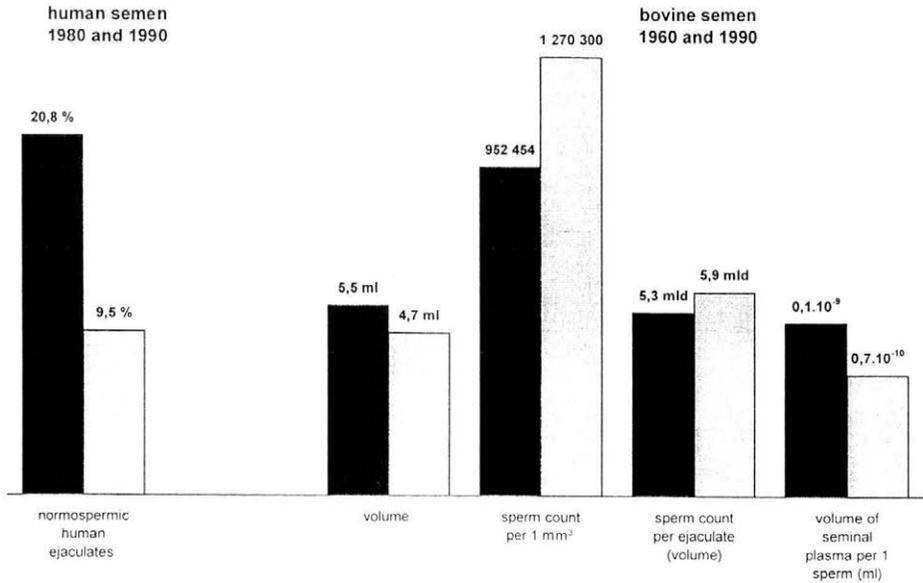
The identification of stress-inducing factors is very difficult owing to the complexity of the adverse effects. The term "civilization diseases" applies rather to social and mental disorders, while adverse environmental factors include particularly toxic effects of xenobiotics, xenoestrogens, etc. Concentrated attention must be paid to a set of factors that can be summarized under the term herd management practices or life style and that covers chemical, epidemiological toxic and mental factors that can, favourably or adversely, influence the organism of man or animal. Stress can be defined as a state in which the organism mobilizes its defence and correction mechanisms developed during ontogenesis that induce the activation of somatomotoric, visceromotoric and neurohumoral reflexes. The latter include increased release of ACTH and suppressed release of gonadotrophins. It has been demonstrated that chronic stress is accompanied by suppression of gonadotrophic activity resulting in a decrease of testosterone levels, as well as suppression of responsiveness of target tissues,

as documented by a weak *in vitro* response of cells to gonadotrophic stimulation. The effects of stressors result in hyposteroidaemia with all adverse consequences in sexagen-controlled target tissues.

Stress affects not only diencephalon, hypophysis and adrenal glands, but also peripheral tissues. As mentioned above, increased release of corticosteroids leads to a suppression of testosterone production via the inhibition of the hypothalamo-hypophysary control mechanism. In this context, the role of opioid peptides released from hypothalamus and their participation in the inhibition of the hypothalamus-hypophysis-testicle axis is also discussed. Persisting stress reduces the susceptibility of Leydig cells to gonadotrophins and blocks the synthesis of testosterone. It is probable that catecholamines and the arginine-vasopressin system, acting via testicular pressure receptors, also participate in these events. Increased levels of corticosteroids can inhibit directly the production of testicular androgens.

Low testosterone levels were found in our investigations of individuals exposed to chronic stress-inducing factors. Like other authors, we obtained similar results also after experimental induction of chronic stress. Low testosterone levels found in young bulls exposed to chronic stressors were associated with a low volume of ejaculates reflecting a reduced activity of accessory glands. Our attention concentrated on the demonstration of qualitative changes in ejaculates or spermatozoa of chronically stressed animals under field conditions. Moreover, experimental hypotestosteronaemia was induced and adverse effects of seminal plasma on spermatozoa were defined.

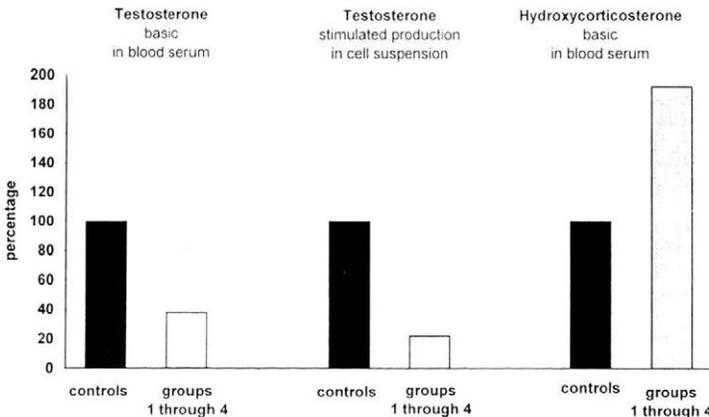
Our experiments and observations were based on a number of papers documenting impaired ejaculate quality. STOLLA and TROMBOCH (1988), who analysed 15 798 bovine ejaculates collected in three A. I. centres during the period 1972–1996, observed gradual decreases in spermatozoa concentration, ejaculate volume and total number of produced spermatozoa. In our laboratory, we compared the results of spermatoanalyses of 3 000 samples collected in 1960 and of 400 samples collected in 1990. The latter set showed a decrease in ejaculate volumes and an increase in spermatozoa concentrations and total numbers of spermatozoa in ejaculates. The most significant was the decrease in the volume of seminal plasma per 1 spermatozoon from 0.1×10^{-9} in 1960 to 0.7×10^{-10} in 1990. Although our data were not in full keeping with those published by other authors, adverse effects of reduced activity of accessory glands were evident.



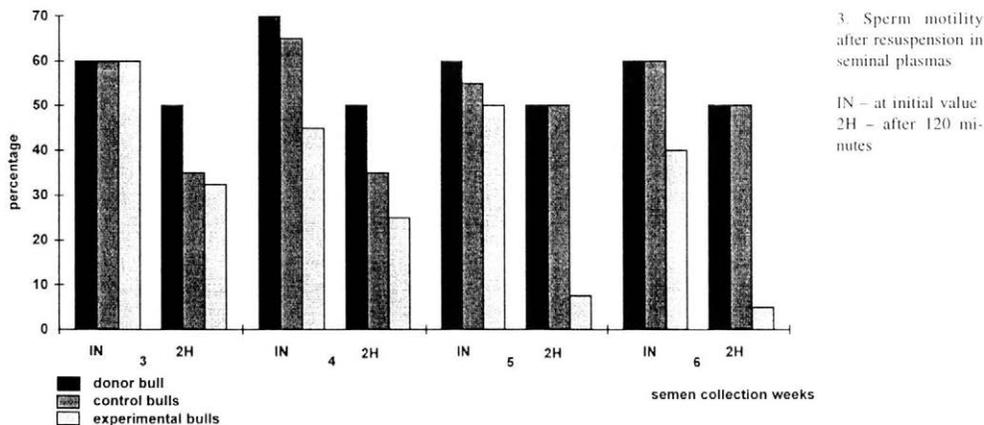
1. Mean values of human and bovine ejaculates

Our investigations have demonstrated suppressive effects of acute stress on the production of testosterone. The dynamics of this response were not the same in all the experimental groups and apparently depended on the period between the induction of stress and blood sampling for the determination of testosterone level. Some authors limit the effect of stress to several minutes to one hour. The initial phase is followed first by a period of resistance and then by a period of depression. The effects of natural stressors are usually chronic. Therefore, we tested the effects of experimentally induced chronic stress in animals exposed to stressors for 22 days. The levels of 11-hydroxycorticosteroids were

lower than in animals subjected to acute stress. Basal testosterone levels reached only 38% and testosterone levels induced in gonadotrophin-stimulated cells *in vitro* only 22% of control values. While the levels of corticosteroids in animals subjected to acute stress immediately before killing were significantly increased, the animals subjected to chronic stress showed only a moderate increase suggestive of an unimpaired function of adrenal glands. The effects of chronic stress were manifested in a significant decrease in blood testosterone levels, depression of gonadotrophic activity and a strong suppression of *in vitro* production of testosterone by testicular cells.

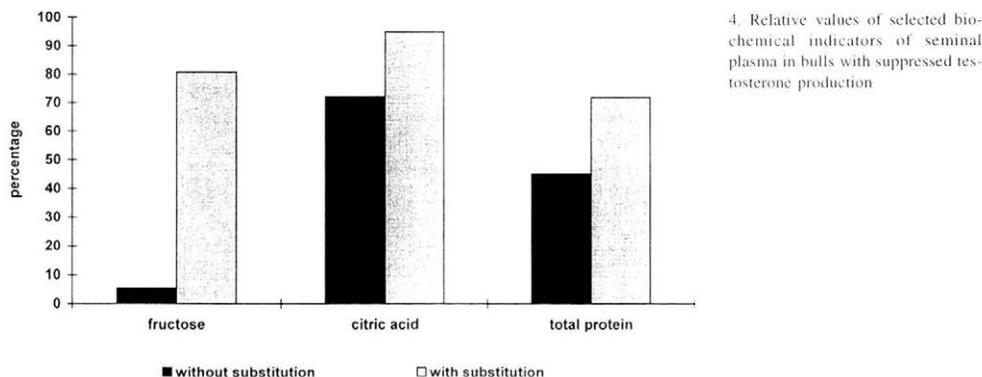


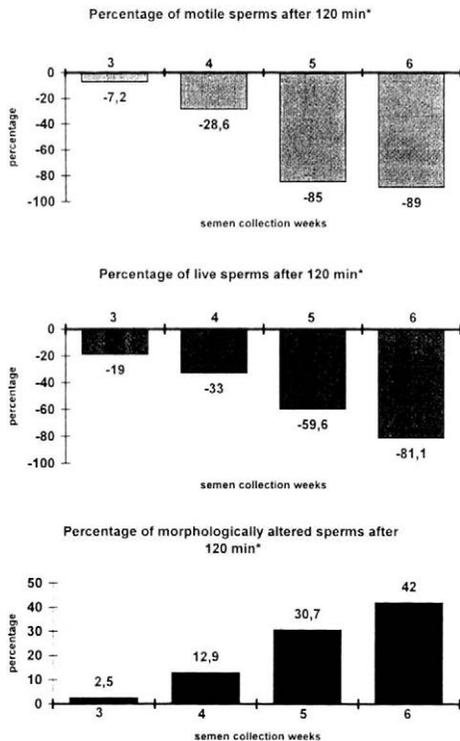
2. Testosterone and hydroxycorticosterone in chronically stressed animals



Adverse effects of low testosterone levels on the quality of ejaculates have been repeatedly confirmed in our experiments. While the effects on spermiogenesis are delayed, the effects on the quality of seminal plasma and on functional parameters of spermatozoa can be detected rather early. Adverse effects of altered seminal plasma composition were investigated using experimental induction of seminal plasma production under conditions of controlled hypotestosteronaemia. Functional parameters of bovine spermatozoa washed and resuspended in such a plasma were compared with those of washed spermatozoa of the same donor resuspended in seminal plasma collected from control bulls. The decrease in the number of motile spermatozoa resuspended in seminal plasma of the hypotestosteronaemic bulls did not exceed 10% in the initial phase of the survival test, but reached 80% after 120 min of the test. A similar decrease was observed also in the percentage of live spermatozoa. An increase by 42% in the percentage of spermatozoa with superficial structural aberrations was suggestive of an impairment of membrane protection by seminal plasma collected from the experimental bulls.

The effect of the resuspension of spermatozoa in seminal plasma of bulls with controlled low or zero levels of blood testosterone is apparently due to the lack of energy sources. Low concentrations of fructose, citric acid and total protein and reduced activity of total and prostatic acid and alkaline phosphatases in such seminal plasmas indicate a reduced activity of accessory glands. In terms of practical implications, however, the increase in the percentage of spermatozoa with superficial structural aberrations determined during the 120-min survival test is more important and the morphological resistance test thus yields an information highly relevant to the assessment of ejaculate quality. This finding apparently confirms an earlier view that shortened sperm survival is due exclusively to a lack of energy sources. The induction of experimental hypotestosteronaemia was associated with a decrease of the protein concentration in seminal plasma below 50%. Like DESNOYERS *et al.* (1994) and MANJUNATHA and SAIRMAN (1987), we regard seminal plasma proteins as a protective component of the spermatozoan membrane system that plays an important





5. Survival tests of resuspended sperms

* percentage relative to control values

role in the membrane modification as a part of the capacitation process. It was demonstrated in our experiments that a substitution of the of endogenous by exogenous testosterone returned the concentrations of fructose and citric acid to normal values, but total protein concentration was still by 20% lower than in seminal plasma of control bulls. The energetic metabolism of spermatozoa is fully dependent on the quality of the membrane system protected by a number of seminal plasma proteins (VĚŽNÍK and ŠVECOVÁ, 1996).

It is apparent that the mechanism of effects of chronic stress involves a number of events induced in the organism by a variety of factors. This conclusion follows from the results of our investigations of infertility in A. I. bulls due to various adverse factors including, among others, malnutrition and toxic agents. In all such cases, an impairment of morphologic resistance of spermatozoa, leading often to impossibility to preserve such ejaculates by deep freezing, was observed.

Studies in male breeder animals have been preferred so far because impacts of environmental factors on the function of male sexual organs are easier to analyse. It

should be pointed out, however, that similar processes have been demonstrated also in herds of female animals, which will become the object of continued studies. So far, we could demonstrate reduced activity of female sexagens in target tissues in cows suffering from serious malnutrition. A comparison with a well-nourished herd showed a decrease in the number of superficial cells in both individual and group vaginal cytograms by approx. 66%. This reduced trophic activity of the vaginal epithelium was accompanied by a limited secretory activity of the cervical cylindrical epithelium and less marked clinical signs of oestrus. Individual variability of such findings apparently results from differences in the level of the internal milieu. While the adaptation mechanisms are species-specific, the condition influencing the adaptation events is characteristic for each individual. The current knowledge of adaptation mechanisms does not allow us to define the adaptation condition in the animals under study. Therefore, indicators giving at least an approximate picture of the balance of the organism and its health in defined environmental conditions should be identified. Qualitative assessment of sexual functions could yield the necessary information. Therefore, methods of this assessment should be further developed, because their results are becoming a valuable information on environmental effects on animal and human organisms.

The results of our investigations should support the role of veterinary ecologists who integrate the views of andrologists and gynaecologists. The result of assessment of male and female sexual functions should also be considered in current monitoring of environmental effects. The tasks of veterinary andrology and gynaecology include the protection of sound environment not only for animals, but also for man. Any occurrence of reproductive failures in animals due to adverse environmental effects is suggestive of a much more serious damage to the human population. Monitoring of reproductive parameters in animals is therefore a task important for the assessment of environmental changes.

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EFFECT OF TRACE AND ULTRATRACE ELEMENTS ON THE REPRODUCTION PERFORMANCE OF RUMINANTS

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INTRODUCTION

The trace and ultratrace element offer to the ruminant species cattle, sheep and goats used in agriculture is determined by the geological origin of their habitat due to the dominating consumption of feedstuffs produced in the region. In industrial conurbations and sometimes far beyond them, industrial emissions pollute the utilisation of several essential trace elements and can lead to secondary copper deficiency in ruminants as it was described for sulphur dioxide, molybdenum and cadmium.

The effects of primary and secondary manganese, zinc, copper, iodine and selenium deficiency on the reproduction performance of cattle, sheep and goats are presented. The influence of the geological origin of the habitat on trace elements are illustrated and species-specific differences are represented in the following.

TRACE ELEMENTS

Manganese

Manganese deficiency symptoms were first registered in cattle on Muschelkalk sites in Thuringia and they were overcome by the supplementation of 2 g manganese sulphate/day. These symptoms manifested themselves as quiet, symptom-poor rut with normal ovulation, which was not or not always registered by the farmer. Quiet rut occurred and occurs mainly in winter, when manganese-poor acre fodder is consumed. The quiet rut caused by manganese deficiency leads to a worse success of the first insemination in goats and cattle (Tab. I). Reproduction disorders in sheep caused by manganese deficiency are connected with keeping in sheepfolds and the exclusive administration of acre fodder and cereals.

In intrauterinely manganese-depleted offspring, manganese deficiency leads to reduced birth weight, deformities of the skeletal system, perosis in chickens, nervous disorders (tapping of the tongue in calves), reduced

life expectancy and disorders in the cholesterol and carbohydrate metabolism.

The deficiency symptoms caused by manganese-deficiency are due to the fact that arginase, pyruvate carboxylase and manganese-dependent superoxide dismutase are manganese metalloenzymes and represent the galactosyl and xyloxy transferase of manganese-activated enzymes. The latter are necessary for the mucopolysaccharide synthesis and thus for the chondrogenesis and the formation of mucus.

The manganese uptake of plants is essentially influenced by the pH value in the soil. The more acid in the soil, the more Mn^{2+} is available for the uptake. With increasing pH values in the soil, manganese is oxidised to manganese dioxide and is no longer available to plants. For this reason, slightly acid, neutral and alkaline soils produce manganese poor feedstuffs (Tab. II). The syenite, slate, granite, phyllite and new red sandstone weathering soils mostly produce a significantly manganese-richer vegetation.

The manganese content in the feedstuffs is influenced by the plant species. Leguminous plants are usually manganese-poor whereas grass species are manganese-richer. There are differences between them, e.g. ryegrass contains little manganese, couch-grass and *Festuca rubra* L. contain much. Like leguminous plants, cereals and rootcrops belong to the manganese-poor feedstuffs. The manganese utilization is impaired by iron, calcium and phosphorus offers which exceed the requirements. These interactions must be paid strict attention to when ruminants are fed.

In the manganese-deficient areas of Germany (Muschelkalk, keuper, and gneiss weathering soils and loess), the mineral mixture for cattle should contain 11 g manganese sulphate or 2.5 g manganese/kg. When 100 g/day are consumed, this offer meets the manganese requirements of cattle of 60 mg/kg ration dry matter.

Manganese intoxications do not play a role in farm animals. Only moufflons on acid forest sites with a grazing of > 1000 mg Mn/kg dry matter can suffer from manganese excess.

I. Effect of manganese deficiency on the reproduction performance of goats and cattle

Parameter	Goat		Cattle	
	control	deficiency	control	deficiency
Success of first insemination (%)	94.0	68.0	64.0	43.0
Abortions (%)	—	23.0	2.0	6.3
Sex ratio, female $\hat{=}$ 1	1.5	2.3	1.0	1.3

II. Influence of the geological origin of the site on the manganese content of the flora in Central Europe

Geological origin of the site	Relative number
Syenite weathering soils	100
Diluvial sands	98
Slate weathering soils (Devonian, Silurian, culm)	80
Granite weathering soils	74
Phyllite weathering soils	73
New red sandstone weathering soils	69
Boulder clay	69
Alluvial riverside soils	69
Moor, peat	69
Weathering soils of the lower strata of new red sandstone	62
Loess	58
Gneiss weathering soils	52
Keuper weathering soils	52
Muschelkalk weathering soils	44
Oderbruch, alluvial riverside soils	43

Manganese deficiency is best reflected by liver, top hair and kidneys. 6 mg Mn/kg dry matter are regarded as the limit value for the black top hair in milk cows and 8 mg Mn/kg dry matter for the liver.

Zinc

Zinc is the component or the activator of > 200 enzymes of the flora, fauna and of humans. Therefore, almost all processes of life are considerably influenced by zinc deficiency. Both male and female individuals are affected by zinc deficiency, with males being more strikingly affected than females. Intrauterine zinc deficiency retards the development of testicles and can impede the beginning of sexual maturity. This comes also true for humans. Zinc-poor feeding reduces the libido sexualis and impedes the potentia sexualis in sexually mature billy goats. Zinc-deficient animals also suffer from impaired spermatogenesis. Considerable amounts of zinc leave the body via the secretion of the prostate gland. Therefore, the zinc requirement of male animals for breeding is higher than that of female ones.

In female ruminants, heat symptoms are not affected by zinc deficiency. The significantly worse success of the first insemination in zinc-deficient goats is triggered by disturbed ovulation (Tab. III). The smaller number of kids per goat carrying to terms also suggests a reduced number of fertile eggs caused by zinc deficiency. On the other hand, zinc deficiency could also reduce the oestrogen binding at receptor proteins and thus, impair the success of the first insemination and the conception rate, resp. Zinc deficiency also led to abortions. Abortions occurred more frequently after the depletion of the body reserves during the second and third gravidity than during the first gravidity of young goats. Gravidity often lasts longer in zinc-deficient animals. Apart from disturbed reproduction, primary and

III. Influence of zinc deficiency on the reproduction performance of goats

Parameter	Control	Zinc deficiency	<i>p</i>
Success of first insemination (%)	80.00	43.00	<0.001
Conception rate (%)	90.00	72.00	<0.01
Abortion rate (%)	–	12.00	<0.01
Number of kids	1.52	1.00	<0.05
Birth weight (kg)	3.36	3.17	>0.05

secondary zinc deficiency causes worse sensations of taste and thus, intake and growth depressions. The keratin synthesis of the zinc-deficient animals is disturbed and leads to skin and hair lesions.

The extension growth of the skeleton of the extremities is reduced by zinc deficiency and this leads to dwarfism and, via the disturbed thymulin synthesis, to a weaker immune system. The learning capacity of the offspring of zinc-deficient animals is restricted due to a smaller volume of their brains.

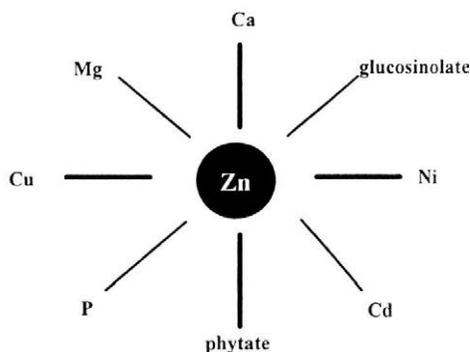
Like in the case of manganese, the zinc uptake of plants depends on the pH value although this is not as distinct as in manganese. Again the weathering soils of Triassic produce the zinc-poorest vegetation (Tab. IV). Boulder clay and loess also deliver little zinc. Syenite, phyllite and granite weathering soils produce significantly zinc-richer feedstuffs.

Particularly many antagonists take a lasting effect on the bioavailability of zinc (Fig. 1). Calcium, nickel and cadmium excesses belong to the most efficient ones in ruminants. A high content of phytate can also affect the utilization of zinc adversely even though to a lesser extent than in monogastric animals.

Ruminants from regions with marginal zinc offer should be given a mineral mixture with 10 g zinc sul-

IV. Influence of the geological origin of the site on the zinc content of the flora in Central Europe

Geological origin of the site	Relative number
Syanite weathering soils	100
Phyllite weathering soils	92
Granite weathering soils	85
Weathering soils of the lower strata of new red sandstone	84
Slate weathering soils	82
Moor, peat	82
Diluvial sands	79
Gneiss weathering soils	75
Alluvial riverside soils	70
Loess	62
New red sandstone weathering soils	61
Muschelkalk weathering soils	59
Keuper weathering soils	52



1. Zinc antagonists

phate/kg or 2.3 g Zn/kg. Thus the zinc requirement of milk cows of 60 mg/kg ration dry matter is met by the administration of 100 g mineral mixture. As a rule, all species tolerate zinc concentrations of 1000 mg/kg ration dry matter although interactions with copper have to be reckoned with. The danger of a zinc intoxication, however is relatively low in ruminants.

The zinc status of ruminants is best reflected by skeleton (ribs), testicles and top hair with decreasing reliability. 40 mg Zn/kg dry matter are regarded as the limit value of deficiency for the ribs of cows and 100 mg/kg dry matter for their black top hair.

Copper

Due to geology and emissions, copper deficiency symptoms in sheep and cattle occur particularly often in Germany. Sheep proved to be most sensitive but cattle and goats reacted to copper deficiency as well.

Copper deficiency can lead to early embryonic death in ruminants which manifests itself in the form of irregularly prolonged heat intervals over more than 32 days. There is a new oestrus after the resorption of the embryo. The success of the first insemination and the seeming conception rate are significantly worse in animals with an undersupply of copper, with heat symptoms being normal (Tab. V). The abortion rate is increased most strikingly. When these findings are interpreted, it must be assumed that the poor success of the first insemination and the insufficient conception rate are also influenced by the early embryonic death, which is difficult to detect. Permanent heat often occurred in goats with copper-poor rations. The birth weight of the kids of goats was not affected by intrauterine copper deficiency. The lacking copper deposits resulted in dramatic growth depressions during the suckling period. The milk is poor in copper. The offspring need the intrauterine copper deposited during the milking period.

Furthermore, intrauterine copper depletion causes endemic ataxia (disturbed myelin synthesis) in sheep. Copper deficiency can lead to skeletal damage, the bursting

V. Influence of copper deficiency on the reproduction performance of goats

Parameter		Control	Copper deficiency	<i>p</i>
Success of first insemination	(%)	80.00	30.00	< 0.001
Conception rate	(%)	90.00	44.00	< 0.001
Abortion rate	(%)	–	57.00	< 0.001
Nymphomaniac goats permanent heat	(%)	–	29.00	< 0.001
Birth weight	(kg)	3.36	3.43	> 0.05
Weight, 70th day of life	(kg)	15.20	8.00	< 0.001

of vessels depigmentation of hair, reduced milk and milk fat production and nervous disorders in all species.

The absence of cytochrome c oxidase, of ceruloplasmin, of the copper-dependent superoxide dismutase, of tyrosinase, of lysyl oxidase, of monoamino oxidase and of other copper-dependent enzyme systems is responsible for these disorders caused by copper deficiency.

The copper antagonists sulphur, molybdenum and cadmium take a lasting effect on the bioavailability of copper in ruminants (Fig. 2).

The copper supply of ruminants in Germany is particularly bad on the ice-age formations of boulder clay, diluvial sands and on moor and peat sites (Tab. VI). These soils are mainly found in North and Central Germany.

Particularly in industrial conurbations, this leads to copper deficiency symptoms, which mainly occur in the kids of sheep and which result in growth depressions in adult cattle.

If there is not any considerable exposure to antagonists, the copper requirements of ruminants amount to

8 mg/kg dry matter. It can be much higher when interactions are expected. This fact, however, must not lead to too abundant a copper supplementation of the mineral mixture since particularly sheep are very sensitive to copper intoxications (Tab. VII). Cattle can also fall ill after the copper depots have been filled up.

The copper status is reflected by cerebrum, liver and, to a certain extent, by the black top hair and the blood serum. 9 mg/kg in the cerebrum of cattle and sheep, 35 mg/kg in the liver, 6 mg/kg dry matter in the top hair and 0.65 mg/l are regarded as limit values.

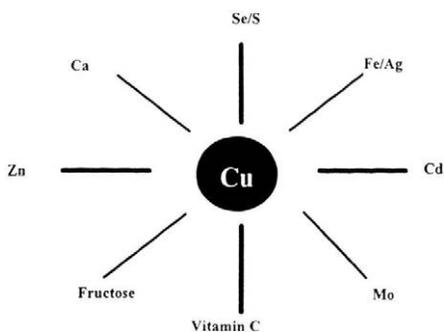
Iodine

Large areas in Germany and in Czech Republic belong to the regions in the world with endemic iodine deficiency. Diseases caused by iodine deficiency occur in animals and humans in these regions. Apart from the enlargement of the thyroid gland, iodine deficiency mainly leads to reproduction disorders (Tab. VIII). They can manifest themselves as quiet heat and an irregular oestrus and result in a reduced success of the first insemination. Repeated services, however, lead to gravidity. The abortion rate can be as high as 50%.

Iodine-deficient goats carried their kids 5 days longer than control animals. On an average, they carried only one kid to terms. Aborted kids as well as those carried to full term had a goitre, some of them had little or no hair, they were weak and underweight.

Iodine deficiency is mainly induced by the erosion of iodine from the sedimentary rocks of the Triassic (new red sandstone, Muschelkalk, Keuper), the weathering soils of the lower strata of new red sandstone and the ice-age formations (Tab. IX).

This erosion is compensated for in the boulder clay and the diluvial sands of northern Germany by the higher iodine content in the precipitations near the



2. Copper antagonists

VI. Influence of the geological origin of the site on the copper content of the flora in Central Europe

Geological origin of the site	Relative number
Weathering soils of the lower strata of new red sandstone	100
Slate weathering soils (Devonian, Silurian, culm)	94
Gneiss weathering soils	93
Phyllite weathering soils	93
Muschelkalk weathering soils	93
Loess	86
Syenite weathering soils	86
Keuper weathering soils	85
Granite weathering soils	82
New red sandstone weathering soils	80
Alluvial riverside soils	74
Boulder clay	70
Diluvial sands	70
Moor, peat	52

VII. Copper intoxications in animals

	Symptoms
Acute intoxication	diarrhoea (blue-green), shock and death in sheep after the intake of > 20 mg Cu/kg feed dry matter
Chronic intoxication	a copper level of < 500 mg/kg dry matter in the liver of sheep is normal. 800 mg Cu/kg liver dry matter lead to a haemolytic crisis, dark-brown urine, a yellow-orange discoloration of the skin, the increase of the copper content to 1000 to 3000 mg/kg liver dry matter
Specificity of species	sheep 10–20 mg Cu/kg ration dry matter, cattle 100 mg/kg, pig 250 mg/kg, hen 300 mg/kg, rat 500 mg/kg ration dry matter

VIII. Influence of iodine deficiency on the reproduction performance of goats

Parameter		Control	Iodine deficiency	<i>p</i>
Success of first insemination	(%)	80.00	30.00	< 0.001
Conception rate	(%)	90.00	86.00	> 0.05
Abortion rate	(%)	0.0	47.00	< 0.01
Length of gravidity	(days)	152.0	158.0	< 0.05
Kids per goat carrying to full term		1.7	0.9	< 0.01
Mortality of kids carried to full term	(%)	27.0	88.0	< 0.001

IX. Influence of the geological origin of the site on the iodine content of the flora in Central Europe

Geological origin of the site	Relative number	Distance to the sea (km)
Alluvial riverside soils	100	210
Diluvial sands	95	150
Boulder clay	94	180
Phyllite weathering soils	92	380
Syenite weathering soils	87	330
Loess	83	300
Gneiss weathering soils	80	410
Slate weathering soils (Devonian, Silurian)	73	280
Weathering soils of the lower strata of new red sandstone	71	380
New red sandstone weathering soils	71	340
Muschelkalk weathering soils	65	340
Keuper weathering soils	61	340
Granite weathering soils	54	410

coast. The iodine content in the rain decreases with increasing distance from the ocean. The drinking water of the coastal region contains almost 10 µg/l, whereas it contains < 1 µg/l in Thuringia and Czech Republic (Tab. X). Ruminants also take in iodine via drinking water, which takes a positive effect on the iodine balance in northern Germany.

The iodination of the mineral mixtures for ruminants with 10 mg iodine/kg led to the filling up of the thyroid gland with iodine within one year and to the iodine accumulation in the milk which reaches a very useful iodine proportion for humans with 80 µg/l (Tab. XI). A higher iodine dose is not recommended since, as it is shown in Fig. 3, an excessive iodine offer also reduces the bioavailability of iodine and leads to goitre.

Milk is an excellent indicator of the iodine status. An iodine content of 50 µg/l milk is regarded as nor-

mal. The iodine requirement of ruminants amounts to 0.3 mg/kg ration dry matter. The bioavailability of iodine is significantly reduced by several interactions (Fig. 3).

Selenium

The essentiality of selenium was only detected 100 or 50 years later than that of iodine, copper, manganese and zinc. Although some tasks of selenium are known, the importance of selenium proteins – apart from glutathione peroxidase and 5'-deiodinase – has still to be clarified.

Reproduction disorders in the form of increased mortality of embryos 3 to 4 weeks after the conception were first observed in sheep. These selenium deficiency

X. Influence of the distance to the sea and the geological origin of the iodine content of drinking water

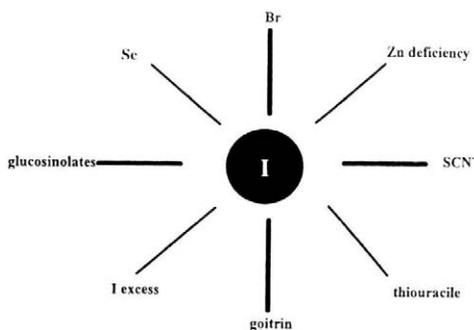
Distance to the sea (km)	\bar{x}	s	Geological origin
60	9	5	boulder clay
120	4	3	diluvial sands
290	4	1	loess
200	4	2	alluvial riverside soils
310	3	2	new red sandstone weathering soils
280	2	0.9	slate weathering soils
370	2	2	weathering soils of the lower strata of new red sandstone
370	2	2	phyllite weathering soils
340	2	1	Muschelkalk weathering soils
340	1	1	keuper weathering soils
410	1	1	granite weathering soils
410	0.9	0.3	gneiss weathering soils

XI. Iodine content in cow's milk before and after the iodination of the mineral mixtures for ruminants

Parameter	1985	1987	1989	F_p	Multiplication	
					1 : 2	1 : 3
\bar{x}	17.0	53.0	81.0		3.1	4.8
s	9.9	35.0	11.0	<0.001		

XII. Influence of selenium deficiency on the reproduction performance of goats

Parameter	Control	Selenium deficiency	p
Success of first insemination (%)	80.0	57.0	>0.05
Conception rate (%)	90.0	62.0	<0.05
Barren animals (%)	10.0	38.0	<0.05
Service per gravidity	1.4	1.9	>0.05



3. Iodine antagonists

symptoms were confirmed in experiments with goats (Tab. XII).

The success of the first insemination and the conception rate of the selenium-deficient animals were worse than those of control animals. One third of the selenium-deficient goats remained barren. The selenium-deficient animals needed 0.5 more services per gravidity than control animals.

The effect of selenium deficiency on cattle is not definite. It needs confirmation. Selenium-poor nutrition led to reduced egg production of hens and a worse hatching capacity of chickens.

Apart from the above-mentioned reproduction disorders, selenium deficiency resulted in reduced feed in-

take, growth depression, muscular dystrophy, exudative diathesis, pancreas atrophy or icteric necrosis due to nutrition, anaemia and a worse immune status. Selenium deficiency leads to a higher proportion of somatic cells in the milk of cattle. The offer of excessive selenium amounts does not bring about a lower number of cells in the milk!

The Keshan disease in China led to a high mortality rate among children and young people.

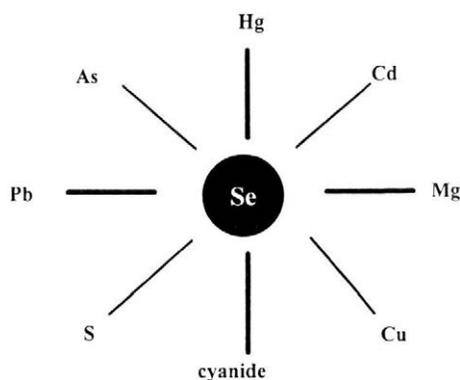
The selenium supply of feeds on acid weathering and boulder clay soils in Germany can be minimal and this can be the cause of muscular dystrophy in young cattle and cows immediately after pasturing (Tab. XIII). This was mainly observed on the gneiss weathering soils of the Bohemian Forest and it was cured by selenium offers.

Just like in the case of other essential trace elements, the bioavailability of selenium is reduced by many interactions (Fig. 4). When hard and brown coal are combusted, – apart from selenium – large amounts of sulphur are emitted as well, which impairs the utilization of selenium. On the other hand, several noxious substances (lead, arsenic, mercury, cadmium and silver) reduce the selenium toxicity in the case of an excessive selenium offer. This is also true for several cyanides which occur e.g. in linseed (Linustratin).

The selenium requirements of ruminants amount to 0.2 mg/kg ration dry matter. Toxic reactions in ruminants need not be expected up to 0.4 mg Se/kg ration

XIII. Influence of the geological origin of the site on the selenium content of the flora in Central Europe

Geological origin of the site	Relative number
Loess	100
Muschelkalk weathering soils	50
Keuper weathering soils	49
Diluvial sands	49
Gneiss weathering soils	47
Syenite weathering soils	43
Slate weathering soils (Devonian, Silurian, culm)	38
Granite weathering soils	37
Phyllite weathering soils	37
New red sandstone weathering soils	36
Gneiss weathering soils (Bohemian Forest)	30



4. Selenium antagonists

dry matter. Higher selenium concentrations already induce reactions of the renal tissue to the high selenium offer.

“Selenosis” mainly occurs in Europe after the import of selenium-rich cereals and after too high selenium supplementations of mineral mixtures. Long-term chronic selenium exposures (1–40 mg/kg ration dry matter) lead to emaciation, anaemia, abnormal growth of hooves and claws, hair loss, worse hatching capacity and increased vitality of chickens. Higher selenium offers induce blindness, pains, salivation, grinding the teeth and paralysis.

The selenium dosages in mineral mixtures must be measured out with much responsibility.

ULTRATRACE ELEMENTS

During the very long passage of inorganic water and the feed components through the fauna, they took on biological tasks as components of enzymes, hormones and proteins in many cases and thus became essential. The requirement for inorganic food components is partially extremely low and is met reliably. Apart from

genetic defects which prevent the utilization of these substances, deficiency symptoms do not occur. Hints as to the biological essentiality of these elements were only obtained in experiments with semisynthetic rations which were extremely poor in the element to be tested. These conditions led to depressed performances, deficiency diseases and reduced life expectancy. These symptoms were not registered in real life since the natural offers meets the requirements partially exceeds them considerably. The biological functions of the above-mentioned trace elements as components of essential parts of the body are not known. They need clarification. The findings presented in the following were registered in growing, gravid and lactating control and deficiency goats in at least fourfold repetition.

Aluminium

With 81 g/kg, aluminum is abundantly available in the earth’s crust. It is the third most frequent element after oxygen and silicon. The aluminium deficiency experiments, which were repeated seven times, were carried out with control and aluminium-deficient rations containing 25 and 0.16 mg Al/kg dry matter.

It was astonishing that, on an average, adult female aluminium-deficient goats consumed significantly more food than control goats (Tab. XIV). The aluminium-poor nutrition did not take a significant effect on the growth of goats but it influenced their abortion and mortality rate significantly. The majority of aluminium-deficient goats died during the first year of life without specific deficiency symptoms. The life expectancy of their kids was extremely reduced as well. It cannot be excluded that traces of aluminium are essential for the fauna. The experiments must be confirmed in other species. The aluminium offer via food meets the aluminium requirements of animals.

Arsenic

Compared to control animals (350 µg As/kg dry matter), the arsenic-poor ration with 35 µg As/kg dry matter did not reduce the feed consumption of growing, gravid and lactating young goats (Tab. XV). Adult arsenic-deficient goats consumed significantly less feed than control goats.

Arsenic-poor nutrition reduced the intrauterine growth of kids by 7%, with the growth difference between control and arsenic-deficient kids increasing to 13% till the weaning from mother’s milk on the 91st day of life. Arsenic-poor nutrition also took a highly significant effect on the reproduction performance and life expectancy of goats. Arsenic-deficient goats usually died of symptoms similar to a cardiac infarction during the second lactation without any previous indications. The mitochondria of the cells of their cardiac muscle showed ultra structural changes. The results of the arsenic deficiency experiments, which were repeated twelve times, demonstrate the possibility that

XIV. Effects of aluminium-poor nutrition of goats

Parameter	Control goats	Deficiency goats	<i>p</i>	%
Feed intake (g/day), adult goats	627	668	< 0.001	106
Live weight, 91st day of life (kg)	17.5	15.8	> 0.05	90
Weight gain, 100th–268th day of life (g/day)	98	101	> 0.05	103
Success of first insemination (%)	74	57	< 0.05	–
Conception rate (%)	90	86	> 0.05	–
Abortion rate (%)	1	14	< 0.001	–
Services per gravidity	1.3	1.8	< 0.001	–
Sex ratio, female $\hat{=}$ 1	1 : 1.8	1 : 2.2	> 0.05	–
Mortality, kids (%)	8	42	< 0.01	–
Mortality, first year of life (%)	0	35	< 0.001	–

XV. Effects of arsenic-poor nutrition of goats

Parameter	Control goats	Deficiency goats	<i>p</i>	%
Feed intake (g/day), adult goats	629	674	< 0.001	107
Live weight, 91st day of life (kg)	18.6	16.2	< 0.001	87
Weight gain, 100th–268th day of life (g/day)	90	75	> 0.05	83
Success of first insemination (%)	75	57	< 0.01	–
Conception rate (%)	89	71	< 0.001	–
Abortion rate (%)	1	1	< 0.001	–
Services per gravidity	1.3	1.9	< 0.001	–
Sex ratio, female $\hat{=}$ 1	1 : 1.6	1 : 1.7	> 0.05	–
Mortality, kids (%)	6	32	< 0.001	–
Mortality, first and second year of life (%)	24	48	< 0.001	–

XVI. Effects of bromide-poor nutrition of goats

Parameter	Control goats	Deficiency goats	<i>p</i>	%
Feed intake (g/day), adult goats	627	572	< 0.001	91
Live weight, 91st day of life (kg)	17.5	16.6	> 0.05	95
Weight gain, 100th–268th day of life (g/day)	98	89	> 0.05	91
Success of first insemination (%)	68	52	< 0.05	–
Conception rate (%)	91	68	< 0.05	–
Abortion rate (%)	1	16	< 0.01	–
Services per gravidity	1.6	1.9	> 0.05	–
Sex ratio, female $\hat{=}$ 1	1 : 1.6	1 : 1.4	> 0.05	–
Mortality, kids (%)	13	30	< 0.01	–
Mortality, first year of life (%)	23	54	< 0.05	–
Haemoglobin (mmol/l)	6.2	4.3	< 0.05	70

arsenic takes on essential functions in the metabolism of the fauna.

Bromine

On an average, the bromine deficiency experiments with 20 and 0.8 mg Br/kg dry matter, which were repeated 7 times, reduced the feed consumption of adult goats with bromine-poor rations by 9% (Tab. XVI).

The reduced feed intake, however, only led to a lower weight gain of bromine-deficient goats after intrauterine bromine depletion. Bromine-deficient goats had a significantly reduced conception rate and a higher abortion rate. The mortality of bromine-deficient kids and their mothers was significantly increased. Bromine-deficient goats suffer from a significant haemoglobin deficiency.

Cadmium

The essentiality of the highly toxic cadmium was systematically investigated in control goats with 300 µg Cd/kg ration dry matter and in corresponding deficiency animals with < 15 µg/kg dry matter. It was demonstrated that the cadmium-poor nutrition did not take an essential effect on feed intake (Tab. XVII). Live weight gain was also not affected by cadmium-poor nutrition whereas cadmium deficiency took a significant effect on the first insemination, the rate of abortion and the number of services. The cadmium-poor nutrition of the mothers affected the activity of their kids most impressively. They suffered from acute muscular asthenia which led to death. The supplementation of the ration with cadmium removed these symptoms and reduced mortality.

Fluorine

Due to its abundant occurrence in the skeleton and the teeth, fluorine is often regarded as an essential element without experimental proofs being available for this statement. Fluorine deficiency experiments with 2.0 mg and < 0.3 mg F/kg ration dry matter, which

were repeated nine times, showed that fluorine-poor nutrition increased the feed intake of the goats (Tab. XVIII) without their live weight gain being better than that of control animals. Significantly reduced growth only occurred after repeated intrauterine fluorine depletion. The reproduction performance was not affected by fluorine deficiency. Only the mortality of goats with fluorine-poor nutrition was significantly increased.

Lithium

Lithium-poor semisynthetic rations took a particular effect on the growth, the reproduction performance and the mortality of goats (Tab. XIX).

This statement is particularly true for the intrauterine development. The significant shift of the sex ratio of kids to the female side is also an interesting result. Lithium-poor nutrition led to a reduced monoaminoxidase in several tissues and to an increased creatin kinase, a stress indicator.

Rubidium

The rubidium offer > 1 mg and < 0.30 g/kg dry matter affected the feed intake only after the depletion of the

XVII. Effects of cadmium-poor nutrition of goats

Parameter	Control goats	Deficiency goats	<i>p</i>	%
Feed intake (g/day), adult goats	629	644	< 0.05	102
Live weight, 91st day of life (kg)	18.2	16.8	> 0.05	91
Weight gain, 100th–268th day of life (g/day)	86	78	> 0.05	91
Success of first insemination (%)	73	46	< 0.001	–
Conception rate (%)	85	72	> 0.05	–
Abortion rate (%)	0	12	< 0.01	–
Services per gravidity	1.2	2.2	< 0.001	–
Sex ratio, female $\hat{=}$ 1	1 : 1.4	1 : 1.5	> 0.05	–
Mortality, kids (%)	8	43	< 0.001	–
Mortality, first and second year of life (%)	30	41	< 0.01	–

XVIII. Effects of fluorine-poor nutrition of goats

Parameter	Control goats	Deficiency goats	<i>p</i>	%
Feed intake (g/day), adult goats	594	841	< 0.001	142
Live weight, 91st day of life (kg)	14.4	14.3	> 0.05	99
Weight gain, 100th–268th day of life (g/day), undepleted	108	107	> 0.05	99
Weight gain, 100th–268th day of life (g/day), depleted	108	82	< 0.05	76
Success of first insemination (%)	67	61	> 0.05	–
Conception rate (%)	81	91	> 0.05	–
Abortion rate (%)	0	3	> 0.05	–
Services per gravidity	1.4	1.6	> 0.05	–
Sex ratio, female $\hat{=}$ 1	1 : 1.9	1 : 1.9	> 0.05	–
Mortality, kids (%)	10	24	> 0.05	–
Mortality, first and second year of life (%)	38	73	< 0.05	–

XIX. Effects of lithium-poor nutrition of goats

Parameter		Control goats	Deficiency goats	<i>p</i>	%
Live weight, 91st day of life	(kg)	17.4	14.8	< 0.001	85
Success of first insemination	(%)	77	51	< 0.001	–
Conception rate	(%)	86	74	< 0.05	–
Abortion rate	(%)	1	14	< 0.001	–
Services per gravidity		1.3	2.0	< 0.001	–
Sex ratio, female $\hat{=}$ 1		1 : 1.6	1 : 0.7	< 0.001	–
Mortality, first and second year of life	(%)	7	41	< 0.001	–

XX. Effects of rubidium-poor nutrition of goats

Parameter		Control goats	Deficiency goats	<i>p</i>	%
Feed intake (g/day), adult goats		766	571	< 0.001	75
Live weight, 91st day of life	(kg)	14.6	11.5	< 0.05	79
Weight gain, 100th–268th day of life	(g/day)	95	99	> 0.05	104
Success of first insemination	(%)	69	46	< 0.005	–
Conception rate	(%)	77	71	> 0.05	–
Abortion rate	(%)	0	88	< 0.001	–
Services per gravidity		1.9	2.0	> 0.05	–
Sex ratio, female $\hat{=}$ 1		1 : 0.9	1 : 1.1	> 0.05	–
Mortality, kids	(%)	9	20	> 0.05	–

XXI. Effects of vanadium-poor nutrition of goats

Parameter		Control goats	Deficiency goats	<i>p</i>	%
Feed intake (g/day), adult goats		634	603	< 0.001	95
Live weight, 91st day of life	(kg)	17.5	15.2	< 0.01	87
Weight gain, 100th–268th day of life (g/day), undepleted		96	60	< 0.001	62
Success of first insemination	(%)	70	48	< 0.001	–
Conception rate	(%)	86	73	< 0.01	–
Abortion rate	(%)	1	19	< 0.001	–
Services per gravidity		1.5	2.2	< 0.001	–
Sex ratio, female $\hat{=}$ 1		1 : 1.6	1 : 0.86	< 0.001	–
Mortality, kids		5	24	< 0.001	–
Mortality, first year of life		11	43	< 0.001	–

body reserves. Intrauterinely rubidium-depleted kids grew significantly more slowly than control kids (Tab. XX). The abortion rate of 88%, which was not registered in any other deficiency experiment, was most striking. The rubidium offer seems to be important for carrying the foetuses to terms. Rubidium-deficient goats usually aborted their offspring in the 5th month of pregnancy. Further investigations must clarify this phenomenon of rubidium-poor nutrition.

Vanadium

A vanadium-poor nutrition with 1 to 9 μg vanadium and > 1000 μg V/kg ration dry matter did affect the

feed intake and the live weight gain of goats (Tab. XXI). It changed the success of the first insemination, the conception rate, the abortion rate, the sex ratio of the offspring, the mortality of kids and their mothers and the skeleton structure of vanadium-deficient goats. They often suffered from skeletal deformities.

SUMMARY

Manganese, zinc, copper, iodine and selenium should be components of the mineral mixtures for ruminants. Among other things, the lack of these ele-

ments in the rations of cattle, sheep and goats leads to element-specific fertility disorders.

The geological origin of the habitat takes a significant effect on the offer of the 5 discussed trace elements. Furthermore, the bioavailability is varied by several industrial emissions and natural substances. They must be paid attention to.

The dosages of copper, iodine and selenium in the mineral mixtures must be measured out very carefully to avoid exposures.

Since the aluminium, arsenic, bromine, cadmium, fluorine, rubidium and vanadium requirements of the fauna are met by feedstuffs and water, ultratrace element deficiency need not be expected. The mineral mixtures for farm animals need not be supplemented with these elements. Investigations with extremely depleted semisynthetic rations in growing, gravid and lactating goats showed that aluminium deficiency only led to unspecific, but significantly increased mortality. Arsenic deficiency induced a moderate conception rate and sudden cases of death during the second lactation whereas bromine-poor nutrition resulted, among other things, in reduced haemoglobin synthesis. Cadmium

deficiency caused a muscular asthenia syndrome which was cured by cadmium offers. Fluorine-poor rations only led to increased mortality in goats whereas lithium deficiency reduced the intrauterine growth, shifted the sex ratio to the female side and increased mortality. Rubidium deficiency induced a high abortion rate, where as vanadium deficiency caused deformities of the skeletal system, a sex ratio shifted to the female side and increased mortality.

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RESIDUES OF HEAVY METALS IN COW REPRODUCTIVE ORGANS AND MORBIDITY OF CATTLE IN THE FALLOUT REGION OF A METALLURGICAL PLANT

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ABSTRACT: The objective of this study was to observe the occurrence of six heavy metal residues (Ni, Cu, Zn, Cd, Hg, and Pb) in ovaries, uteri and cervical mucus of cows in four herds in the fallout region of a metallurgical plant and in one control herd. The aim was to determine the average amount of the above-mentioned chemical elements per kilogram (kg) of fresh tissue and cervical mucus during the induced oestrus as well as to compare the obtained results with morbidity of animals. In each herd, samples were taken from 12 animals. For the collection of cervical mucus, animals with active *corpus luteum* have been selected for the induction of luteolysis by 500 µg of cloprostenol (Oestrophan, Spofa). After 72 hours, a sample of mucus was taken, it was frozen in vapours of liquid nitrogen where it was stored until processing. Ovaries and samples of uterus were taken at a slaughter house. The observed chemical elements were determined by the AAS method on the device of Philips PU q100 except for Hg that was determined on the analyzer of TMA 254 (Tesla, Holešovice, Czech Republic). The highest average concentrations of Hg and Ni in ovaries and uteri were recorded in the herd of HA. Average concentrations of Hg in ovaries were 0.002 ± 0.002 mg/kg and 0.853 ± 0.485 mg/kg, in uteri 0.004 ± 0.004 mg/kg and 1.160 ± 1.77 mg/kg. The highest average concentrations of Pb and Cd both in ovaries and uteri were recorded in the herd of SA similarly like those of Cu, Zn, and Mn in uteri. In the herd of PE were found the highest average concentrations of Cu, Zn, and Mn in ovaries.

In cervical mucus were recorded the highest average concentrations of Cd, Pb and Ni in the herd of PE – i.e. 0.137 ± 0.082 mg/kg, 0.315 ± 0.195 mg/kg and 0.960 ± 0.521 mg/kg, respectively. In this herd (of PE) were found the highest average Cu concentrations – i.e. 0.151 ± 0.113 mg/kg and in the herd of V1 the highest average Zn concentrations – i.e. 4.779 ± 0.98 mg/kg. Individual Cu concentrations ranged from 0.009 mg/kg to 0.784 mg/kg. Concentrations of Zn ranged from 0.907 mg/kg to 9.185 mg/kg. From the morbidity observations (Tab. D) it follows that there is significantly higher prevalence of the diseases of reproductive organs in the exposed herd from the fallout region when compared to control one.

I. Morbidity of cattle

Herd	Number of animals	Diseases											
		Aliment.		Respir.		Udder		Reprod.		Legs		Other	
		n	%	n	%	n	%	A	%	A	%	n	%
CA	1302	180	7.90	80	3.52	581	35.53	871	38.27	513	22.54	51	2.24
BU	845	10	2.34	9	2.10	48	11.32	301	70.33	34	7.94	26	6.60

CA – control herd, BU – exposed herd

In conclusion, the observed heavy metals are deposited into the tissues of ovaries and they are heavily excreted into the cervical mucus at the time of induced oestrus. The results of the observation point out to the possible effect of heavy environmental pollution by heavy metals on the morbidity of cattle, particularly the diseases of reproductive organs.

heavy metals; influence on cow reproductive organs; morbidity of cattle

CONCENTRATION OF THYROID HORMONES IN COWS WITH OVARIAN DYSFUNCTIONS

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ABSTRACT: Objective of the present study was to assess the function of the thyroid gland in cows with natural and experimentally induced ovarian dysfunctions, and to analyse the relations between thyroid and ovarian hormones. In the serum of cows without any clinical signs ($n = 30$) the average concentration of triiodothyronine (T_3) was 1.79 ± 0.80 and thyroxine (T_4) 79.00 ± 3.80 nmol/l (mean \pm SEM) and the values varied in dependence on the reproduction cycle stage. Production of T_4 was significantly lower ($P < 0.05$) in cows until the day 60 after parturition compared with lactating cows more than 60 day after parturition, 68.29 ± 6.38 nmol/l, 90.29 ± 7.47 nmol/l, respectively. The lowest values of T_3 (1.52 ± 0.05 nmol/l; $P < 0.01$) were determined in the group of cows under dry condition compared with lactating cows. Significantly lower concentrations of T_4 (55.30 ± 1.73 nmol/l; $P < 0.01$ and 66.54 ± 2.80 nmol/l; $P < 0.05$) were found in cows with ovarian cysts ($n = 49$) and in those with postpartal acyclic ovaries ($n = 40$). Significantly lower concentrations of T_3 (1.23 ± 0.09 nmol/l; $P < 0.01$) were found in acyclic cows. In cows with persistent ovarian cysts, low production of T_4 was even more pronounced (50.24 ± 4.40 nmol/l), though insignificant, at increased production of 17β -estradiol ($E_2 \geq 20$ pg/ml). On the other hand, in cows with increased concentration of progesterone ($P_4 \geq 1.0$ ng/ml) due to simultaneous occurrence of *corpus luteum*, the inhibition of T_4 production was less pronounced. Highly significant negative correlation was found between E_2 and T_3 ($r = -0.42$; $P < 0.01$) in cows with ovarian cysts. Antagonism between estrogens and thyroid hormones was also confirmed in 4 cows following induction of ovarian cysts by application of higher dose of PMSG. Increased production of E_2 , culminating on days 3–6 after the treatment (42.52 ± 19.08 and 23.88 ± 5.13 pg/ml), with a gradual decrease till day 20, was accompanied with decreased production of T_3 and T_4 , in case of T_3 statistically significant ($P < 0.05$) on days 13–29 after the treatment. The obtained results support the theory about participation of thyroid gland disorders in etiopathogenesis of ovarian dysfunctions. The mechanisms of negative effects of hypothyreosis on the function of reproductive organs have not yet been completely elucidated. Regarding the frequently diagnosed insufficient saturation of cows with iodine and occurrence of goitrogenic agents in feeds, it is necessary to pay attention to these questions while analysing the causes of fertility disorders.

thyroid hormones in cow; ovarian dysfunctions

NEGATIVE ENVIRONMENTAL FACTORS ON FERTILITY

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ABSTRACT: The fact that the incidence of infertile marriages is on the increase throughout the world, has stimulated a greater interest in identifying possible effect of the environment on the fertility of both man and woman. Over the last 50 years the average number of spermatozoa in the ejaculate has decreased by about a half. The present review takes a look at recognized noxae (ionising radiation, lytoestrogens, herbicides, pesticides and detergents) and their effect on fertility. There are also mentioned negative factors of lifestyle (smoking, alcohol etc.). A variety of environmental agents have been implicated as etiological factors in repeated pregnancy loss, too. These include the use of prescription and illicit drugs, caffeine, tobacco, and alcohol as well as exposure to radiation, pesticides, and other occupational toxins.

environmental agents; influence on fertility

IMPORTANCE OF ANTIBODIES TO THE SPERMS IN BLOOD SERUM OF BULLS AND ASSOCIATION WITH EJACULATE QUALITY

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ABSTRACT: 690 blood sera of bulls of different age and breed from artificial insemination stations and bull rearing stations were examined by enzyme-linked immunosorbent assay (ELISA) for the presence of antibodies against sperms (AbS). At blood serum dilution 1 : 40, 35.5% of positive animals were detected. Occurrence of antibodies has been determined since the age of 5–6 months, and was significantly higher ($P < 0.05$) in age category 9–10 months. In active semen donors the finding of AbS was significantly higher (56.4%, $P < 0.01$) compared with bulls in which irregular semen sampling had been performed (39.2%). Higher frequency of antibodies has been found in bulls of Black-Pied Holstein breed and their cross-breeds compared with Czech-Pied breed and their crossbreds (48.4 and 35.2 %, $P < 0.01$).

Formation of antibodies, the titre of which reached the dilution 1 : 320, has been induced by a repeated immunization of seven bulls by their own sperms. After immunization, antibody titres did not tend to drop and persisted another 6 months after its finishing. No marked changes in ejaculate volume and concentration of the sperms were observed at spermatological examination. Assessment of sperm motility and velocity of the movement revealed that in 2–3 weeks intervals a marked undulation of the initial values occurred as well as after 120 min in the thermal test the difference exceeding in some cases 30 to 50%. In four bulls a noticeable tendency in agglutination of sperms by their heads was recorded. Ejaculates of all the immunized bulls were evaluated as unstable.

Complex spermatologic analyses of 50 breeding bulls performed under field condition of a large Artificial Insemination Station showed the differences of average values of individual indices of ejaculate quality between bulls with a negative AbS finding and a low titre (1 : 40) of AbS and breeding bulls with higher titres (1 : 80 to 1 : 320). Ejaculate volume was about 8% higher and sperm concentration about 19% higher in the group of negative bulls compared with positive ones. Drop of motility, percentage of live sperms, velocity of their movement and index of endogenous reduction was 7.1, 5.8, 6.6, 9.0%, respectively, in positive bulls during a 120-min thermal test of resistance compared with negative bulls. On the other hand, higher percentage of pathological sperms (by 13.9%) and increase of secondary changes of sperms by 19.1% were recorded in positive bulls compared with bulls negative to AbS.

Determination of sperm penetration into the cervical mucus obtained from both heifers positive and negative to AbS revealed significantly lower penetration rate ($P < 0.05$) in the mucus of positive heifers after 30 and 60 min.

sperm antibodies in bulls; ejaculate quality

AIR POLLUTION AND SEMEN QUALITY IN YOUNG MEN RESIDING IN TWO CZECH COMMUNITIES

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ABSTRACT: Semen quality in 325 18-year old men from two communities in the Czech Republic and air pollution were examined: One was a heavily industrialized district (Teplice) with high air pollution, the other, an agricultural district with lower air pollution (Prachaticce). Both districts had seasonal variations in air pollution, with higher levels in winter. The very high winter exposures in Teplice were due to higher coal usage and climatic conditions. Surveys in the fall and late winter, included interviews, physical examinations, and collection of semen samples. Measures of semen quality included concentration, volume, motility and morphology, computer-aided motion analysis, and sperm chromatin structure assay. Men were classified into exposure groups using relative levels of ambient sulfur dioxide, ranging from 6.0 to 164.0 mg/m³. Adjusted analyses identified significant associations (OR (95% CI): < 13% morphologically normal sperm (medium exposure: 4.1 (1.2–13.9); high exposure: 10.1 (2.8–36.0)), < 29% sperm with normal head shape (medium exposure: 6.1 (2.0–18.4)); < 24% motile sperm (medium exposure: 9.8 (3.6–27.2); high exposure: 3.5 (1.1–11.5)). Exposure was not associated with lower semen volume, count, concentration or sperm motion outcomes. These results suggest that exposure to high levels of air pollution may produce adverse, but transient effects on sperm morphology and motility.

air pollution; semen quality in young men

INFLUENCE OF CADMIUM ON GAMETES AND EARLY EMBRYOS OF PIGS *IN VIVO* AND *IN VITRO*

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ABSTRACT: Experimental boars ($n = 5$) and gilts ($n = 5$) was loaded by cadmium (Cd). The animals were fed diets containing 1 mg of cadmium sulphate per kg of body weight from weaning to puberty. Examination was performed after collection in boars of semen quality. The survival of the spermatozoides was shorter in temperature test and the differences of concentrations of fructosis and lemon acid were statistic significant (fructosis 7.56 ± 2.49 nmol/l : 3.67 ± 3.15 nmol/l = $P < 0.01$ and lemon acid 40.08 ± 9.17 nmol/l : 34.9 ± 3.15 nmol/l = $P < 0.01$). The gilts in heat were inseminated with fresh semen and on the day 3 after estrus were obtained embryos and oocytes after laparotomy by flushing of the apical part of the uterine horns or oviducts. The quality of ovulation was similar in experimental group of gilts in comparison with control group (number of *corpora lutea* – CL were 12.4 : 13.0), but this rate between sows in experimental and control group was 13.2 : 12.0 CL, respectively. The average yield of embryos from succesful flushed gilts were 9.6. The fertility of oocytes from loaded gilts were about 13.5% lower than in gilts from control group, but the results were not statistical significant ($P > 0.01$). The quality of embryos originating from cadmium-exposed gilts did not differ compared to embryos collected from control gilts. The embryos were cultured (*in vitro*) for 96 hours with normal development potency. Culture in medium containing 1.5 and 10 $\mu\text{mol/l}$ of the cadmium acetate did not evoked any degeneration or morphological changes in early embryos. The long term load of Cd (1 mg per kg of body weight daily) partly decreased resistance of spermatozoides (temperature test), but it did not influence the fertility. The gilts did not show lower rate of ovulation, fertility of oocytes, nor early embryo development.

cadmium; influence on embryos of pigs

INFLUENCE OF CADMIUM ON BOVINE GAMETES AND EARLY EMBRYOS *IN VIVO* AND *IN VITRO*

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ABSTRACT: Seven pluriparous cows on diet supplemented with 1 mg cadmium sulphate per kg of body weight daily were used for study of influence of cadmium (Cd) on gametes and embryos *in vivo* and *in vitro*. Five cows was loaded from 183 to 338 days before superovulation (group I) and two cows was superovulated 120 days after the finishing of 68–75 days loading by Cd (group II). The average numbers of follicles in both group were 10 and average number of *corpora lutea* (CL) were 8.5 and 8.4. The numbers of normal fertilized oocytes were 44 (77.19%) and 11 (52.38%) and the numbers of abnormal fertilized oocytes were 5 (8.77%) and 2 (9.52%) in the group I and II. The average numbers of normal quality oocytes were 8.5 and 5.5 per cow. Further evaluation of early embryos from superovulated cows after long term of loading by cadmium showed that only 2% of them were clasified as degenerated or unfertilized. The embryos were frozen for three days in liquid nitrogen and after this period they were thawed and 90% of them showed good viability. They did not show any differences in the viability after 24-hour culture between loaded and unloaded cows (i.e. 50% of embryos). The similar results showed the cultured embryos after 48 and 72 hours. The superovulation rate, fertilizability and early embryonic development of embryos did not show difference between loaded and unloaded cows. *In vitro* cultured embryos in medium containing 1.5 and 10 $\mu\text{mol/l}$ of cadmium acetate for 48 hours showed symptoms of degeneration. After 24 hours the embryonic cell mass got dark and the embryos degenerated completely during next 24 hours. The similar investigation of *in vitro* influence of Cd on spermatozoides by culture in medium containing 3.1% sodium citricum and 6% glucose (1 : 1) and 10, 50, 70, 100 and 200 $\mu\text{mol/l}$ of cadmium acetate was performed. The motility of the spermatozoides after dilution with Cd for three hours was similar or higher than at control semen. The motility of the spermatozoides exposed to concentration 200 $\mu\text{mol/l}$ of cadmium acetate decrease after 4–6 hours.

cadmium; influence on bovine embryos

DIFFERENCES IN BURDEN OF PIG AND CATTLE FARMS BY HAZARDOUS POLLUTANTS

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ABSTRACT: Burden of pig ($n = 3$) and cattle ($n = 2$) farms with selected hazardous pollutants (mercury, cadmium, lead, lindane, DDT, PCB) was monitored in the district Hodonín in the period 1994–1997. The pollutants were monitored in feeds ($n = 81$), drinking water ($n = 47$), stable dust ($n = 48$), road dust ($n = 24$), soil ($n = 17$), porcine liquid manure ($n = 27$), hair ($n = 85$), milk ($n = 27$), muscles ($n = 51$), kidneys ($n = 51$) and fat ($n = 51$). Higher levels of DDT (0.010 mg/kg) and PCBs (0.011 mg/kg) were found in feed mixtures for swine compared with those for cattle (DDT 0.002 mg/kg, PCB 0.005 mg/kg). Higher mercury level (0.011 mg/kg) was found in roughages for cattle compared with feed mixtures for cattle (0.002 mg/kg). In stable dust from the pigsties, higher PCB level was found (1.226 mg/kg) compared with stable dust from cowsheds (0.035 mg/kg). Higher lead levels were found in cattle hair (0.81 mg/kg) than in swine bristles (0.18 mg/kg). Extremely high levels of PCBs (8.99 mg/kg of dry matter) were recorded in porcine liquid manure, and relatively high levels of DDT (0.063 mg/kg of fat) were also found in milk. Higher cadmium level (0.298 mg/kg) was found in kidneys of cattle compared with porcine kidneys (0.138 mg/kg). Insignificantly higher levels of PCBs (0.120 mg/kg of fat), DDT (0.076 mg/kg of fat), and lindane (0.034 mg/kg of fat) were found in cattle fat (fat capsule of kidney) compared with porcine fat (subcutaneous fat). Pig and cattle farms did not practically differ in the burden of drinking water, road dust, soil, and muscles with hazardous pollutants. The major task of the veterinary service is to search for pollution sources and ways of transmission of the hazardous pollutants into swine and cattle herds, and to propose effective ways of prevention to protect animal health (and that of their tenders) and the food chain.

pig and cattle farms; feed; drinking water; stable dust; liquid manure; road dust; soil; hair; muscles; kidneys; fat; mercury; cadmium; lead; lindane; DDT, PCB

ESTROGENIC ACTIVITY OF XENOBIOTICS

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ABSTRACT: Environmental contaminants, drugs and other xenobiotics have been found to affect both reproduction and developmental processes in various organisms. Exogenous compounds that mimic or inhibit the effects of endogenous hormones are known as endocrine disruptors. Recent studies have been focused mainly on mechanisms of action of estrogen-like compounds (xenoestrogens). Some synthetic steroid analogues, phytoestrogens, and many environmental pollutants such as metabolites of organochlorine pesticides, degradation products of surfactants, dialkyl phthalates, are considered to be the most important of them. The objective of this review has been to summarize the currently known mechanisms of action of endocrine disruptors and methods suitable for a detection of their effects. Recent studies show that the effects of xenoestrogens include interactions not only with the estrogen receptor (ER) pathway but also with other receptor systems. Beside the receptor-mediated effects, various other mechanisms exist that may modulate the endocrine system, including modulations of steroidogenesis and drug-metabolizing enzymes. A number of biochemical and cellular methods for the assessment of endocrine disruptors, allowing both the identification of individual chemicals as xenoestrogens and evaluation of their potential risk in the environment, are being developed and implemented. A combination of both *in vitro* and *in vivo* methods (e.g., recombinant receptor/reporter gene assays and detection of vitellogenin in plasma as well as the determination of activities of key steroidogenic and steroid-metabolizing enzymes) seems to be the most appropriate strategy.

endocrine disruption; xenoestrogens; cytochrome P450; steroid synthesis; vitellogenin; reporter gene assay

The full text of the paper will be published in issue No. 10.

THE YEAST *CANDIDA GUILLIERMONDII* AND ITS IMPACT ON REPRODUCTION

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ABSTRACT: *Candida* spp. are important opportunist pathogens that infect medically compromised individuals. The most commonly isolated species is *C. albicans*. Species that have been isolated from humans and animals with reproductive disorders include *C. tropicalis*, *C. pseudotropicalis*, *C. krusei* and especially *C. guilliermondii*. Sources of the infection are contaminated foodstuffs, feed and drinking water.

In eight dairy farms, reproductive disorders were reported by increased number of repeat breeders, prolonged service period and permanent infertility. In these farms, using serological screening methods, the study has been carried out on 358 cows with chronic inflammatory lesions of reproductive organs or symptomless repeat breeders. Of them 115 (32.1%) were found agglutination reaction positive to the yeast antigen *C. guilliermondii*. This is a highly significant prevalence ($P < 0.01$) as compared with 3 (4.9%) positive animals out of 61 cows with no reproductive disorders. Clinically manifested pathological lesions of the reproductive organs, the number of cows with prolonged service period and repeat breeding were in coincidence with the intensity of serological reaction. In addition, from 84 affected cows examined by both serum agglutination test and ELISA, 38 (45.2%) were ELISA positive, of which 18 were in serum agglutination test positive as well. Out of 46 ELISA negative sera, 31 samples were also found negative by agglutination test, the remaining 15 being positive only in agglutination test. A total of 8 sexually mature rabbits (4 males and 4 females) were experimentally infected with *C. guilliermondii* by oral or intravenous administration. Prior to infection, two bucks and two does were treated with corticosteroids. The investigation was carried out to study spermatological characteristics, immunological responses, isolation of the pathogen from parenchymatous and genital organs, and to assess the impact of this pathogen on fertility.

Concentration and motility of sperms temporarily declined (one month after infection), whereas the percentage of pathologically altered sperms increased. Two does pre-treated with corticosteroids died in the second week after the infection. The remaining two does permanently failed to conceive after mating with the three control bucks. Nevertheless three control does mated with infected bucks (two months after infection) were found to conceive, but one of them have one stillbirth and two remaining does had a small number of offsprings, which most of them died right after birth or later.

Findings on necropsy of dead and sacrificed animals revealed multi-focal lesions on the lung, kidneys and liver. Microscopic examinations of smears from these organs were positive to this yeast. Specimens collected from the above organs, blood, ejaculates and vaginal swabs were cultured on Sabouraud's agar resulting in a characteristic colony. Culture isolation of the yeast from the organs of an aborted fetus was also positive.

Candida guilliermondii; cows; serology; agglutination test

ENDOCRINE ANOMALIES IN FISH CHRONICALLY EXPOSED TO ENVIRONMENTAL XENOBIOTICS

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ABSTRACT: The natural environment is a multifactorial matrix that continuously challenges the homeostasis of living organism. The capacity to activate the hypothalamopituitary – adrenal axis and to increase blood levels of catecholamines, mineralocorticoid and glucocorticoid hormones in response to an acute exposure to a stressor is a fundamental process that favours survival. In teleost fish, an increase in plasma levels of cortisol, the major glucocorticoid of this group of vertebrates, can be generated through acute exposures to physical stressors such as confinement, or chemical stressors such as sublethal doses of heavy metals (Cd, Hg). We have diagnosed, through experimental work in the field and in the laboratory, an important endocrine dysfunction in fish that are chronically exposed to environmental xenobiotics in their environment. Populations of yellow perch, *Perca flavescens*, from areas in Eastern Canada impacted by industrial contaminants, specifically heavy metals, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and bleached kraft mill effluents (BKME), have a significantly impaired capacity to generate the normal physiological and hormonal response to an acute stress. We have used standardized physical stressors (capture or timed confinement stress), as well as hormonal (treatment with ACTH, adrenocorticotropin) *in vivo* with whole fish and *in vitro* with isolated pronephros where the cortisol secreting steroidogenic cells are located in teleost fish, to generate the maximal cortisol secretion. Our studies provided evidence that the secretory capacity is diminished in fish chronically exposed to xenobiotics, compared to fish from a matched reference (unpolluted) site. Recent work using pronephros exposed to xenobiotics *in vitro* has enabled us to make functional relationships between the internal dose of the xenobiotic that accumulates in the pronephros through chronic exposures and the degree of secretory impairment characterized by diminished output of cortisol. Our data can be used in the assessment of impact of environmental xenobiotics on the physiological and endocrine integrity of organisms chronically exposed to sublethal doses in the aquatic environment, as well as in development of simple bioassays usable in Endocrine Toxicology.

stress; fish; endocrines; pathology; xenobiotics; chronic exposure

THE VALUE OF HUMAN LIFE AT THE END OF THE NEXT CENTURY

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By projecting the body of today's data and information related to the evolution and to the present image of the species HOMO, we are trying to paint the world of the Man and his Value of Life at the end of the next Century. First of all, we have to realize that the qualitative and quantitative evaluation of the Value of Life (later VL only) demands a very individual approach which has always been affected by the subjective attitude of the evaluator. A number of factors are involved (e.g. cultural, political, religious, tribal custom etc.) which all could profoundly affect the results of life's values estimations. KELLERT (1996) differentiates between the definitions of Life Values into nine basic categories: 1. utilitarian (pragmatic use), 2. naturalistic (saturation of the direct experience of nature), 3. ecological scientific (studying and understanding the biological structure of life), 4. aesthetical (the appeal of beauty pleasurable emotional responses and a sense of Awe), 5. symbolic (use of thought and communication), 6. dominionistic (changes of mastery, control, and survival), 7. humanistic (emotional bounding, companionship), 8. moralistic (spiritual revenue and ethical concern), 9. negativistic (fear and aversion).

An excellent example of how Values of Human Life could be considered as relative is a 74 year old American widow who recently won a 12 mill. dollar lottery. She didn't use the money, but gave it to her church, to local schools, and to her three nephews. She reasoned that she could not make her life better. She estimated the value of her life by the highest score at the life schedule. In Kellert's conception, all her basic categories of LV's were optimal. This situation might be of course dramatically changed if she was paralysed the next day. Her VL could diminish profoundly, but she would be able to buy her temporarily lost VL by providing herself with sophisticated supporting technology, buying a surgical intervention, or buying appropriate auxiliary personal service and necessary medication. The VL of a millionaire suffering from a metastatic disease with unbearable pain not responding to analgesics would be extremely low, or rather nil. The VL could increase for him, in short time preceding the death, a period often characterized by the disappearance of pain and associated with euphoric feelings. A mental patient suffering from severe depression and unbearable pain of fear in the moment of suicidal dying very often expressed patterns of immense satisfaction and happiness. "Near to death" conditions induced e. g. by suffocation, might induce feelings of euphoria and it might seem paradoxical but the "intrinsic" VL of

such a suicidal victim might be very high during the process if dying.

In the future human life will be certainly more affected by environmental changes than it is today. The environmental changes, which started about two centuries ago with the Industrial Revolution show progressive tendencies. We have good reasons to presume that the deteriorating process affecting the Nature, i. e. the environment, will continue reaching deep into the next century. There is a hope that the scientific, particularly the technical progress will enable Man to survive biologically and it is possible that the natural environmental condition will be successfully replaced by artificial ones. It means the environment (i.e. the Nature), will be under control of Man and appropriate protection will be found to fight the virtually uncontrollable climatology crisis.

The global warming originating from the diminishing of the ozone layer by Greenhouse gasses will hopefully be stabilized at the middle of the next century and will start to improve at the end of the next century. UV radiation inducing change in the distribution of superficial water will oblige Man to change food composition. The latter will be mostly of vegetarian type because the animal food chain will be more effected by infection and radioactivity. The cause of the increased radioactivity will be several wars and terroristic attacks in which the nuclear weapons will be used. A further source of radioactive pollutions will begin in accidents occurring in the nuclear power energy. It is very likely that the resistance of germs against antibiotics and other germ growth inhibiting factors produced by pharmaceutical industry will further increase. In the evolution of infectious diseases, an important factor will be megacities in which most of the Earth population will be concentrated in the second half of the next century. This extensive urbanisation will create entirely different attitudes concerning the VL.

It would be mistakable to see this futuristic vision only doomy and gloomy. The human life will gain many positive aspects too: it is possible to presume that humanity will be in possession of an indefinite source of pure and pollutionless energy produced by new technology (e. g. solar, fusion, fuel cell energy). The use of fossil energy was abandoned many years ago. The threat of war will not exist because there will be a control of sky, earth and oceans preventing any unexpected attack. The Human Genome will be resolved within the first decades of the next century, not only concerning its structural, but also the bioclinical functional aspects

will be known. Because most of pregnancies will be artificially induced using the data from the involved genomes, diseases and any pathological conditions among people will be extremely rare. The food and water will be sterile, water will be obtained by desalination and by chemical syntheses, particularly from fuel cells technology which will become a regular component of housing complexes. The system of megacities will for many reasons exclude the living in individual houses as we know it, particularly in North America, today. Most of human habitat will have an air filtration device preventing inspiration of radioactive and germ elements. Despite the fact that the biochemistry of the aging process will be well known, the human Life Span for many reasons will not be extended beyond the age of 65. The terminal stages of death and dying will be under perfect control and therefore fear and anxiety over death will not exist. People living at the end of the next century will hardly understand how their ancestors could live knowing with certainty that they will die but not knowing when and then will die.

It is obvious that the vital environment and human life will be at the end of the next century profoundly different. But it has to be mentioned that many of the patterns appearing in our futuristic vision could be already traced today as slightly visible tendencies. We are already in the process of mass urbanisation, we have already polluted the environment with noxious chemical waste and radioisotopes, we are already dealing with the process of global warming and we are approaching to the final reading of the Human Genome. It is very likely that the reproductive technology will reach in a not so far future the stage of cloning. Infectious germs (incl. insect and several animal species) are becoming more and more resistant to our chemical defense agents, particularly against antibiot-

ics, fungi-, weed-, and other pesticides. It is quite clear that any attempt to establish quantitative or qualitative standards of the VL becomes more and more difficult. Statistical data obtained today about the life expectancy, life span, perinatal mortality, animal protein and water consumption as indicators of the Life quality, will have different meaning in the future, or will become entirely meaningless. Dynamics of the VL might be demonstrated by the changing attitude of the very old age. Only one hundred years ago in the UK everybody who became centenarian got a congratulating letter and a golden coin from the Queen. But, at the beginning of this century, the number of centenarians increased so much that this good custom was abandoned. The population in age group 85 and older became the fastest growing segment of the general population, of course, in industrialized countries. Their VL might be estimated by themselves and by the social care institutions in different ways. It would depend on the physical and mental health and on the wealth of the very old subjects. Paradoxically, the loss of insight and judgement might increase the "intrinsic" VL because the deteriorating physical and mental conditions could not be, by the so affected individual, realized.

Concluding this delicate subject, we find the VL has been raised inappropriately high in industrialized and so called developed countries. The VL can be reversed very easily as we have seen recently when more than one hundred million people died in two world wars and another ten million perished as prisoners. Many of these people were killed because they lost the VL for their executioners. But there are dispersed populations over the world who feel no possession of any VL due to their religion or tribal philosophy. They can die without fear and anxiety just because they do not feel any VL by living in this Planet.

POKYNY PRO AUTORY

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If any abbreviation is used in the paper, it is necessary to mention its full form at least once to avoid misunderstanding. The abbreviations should not be used in the title of the paper nor in the summary.

The author shall give his full name (and the names of other collaborators), academic, scientific and pedagogic titles, full address of his workplace and postal code, telephone and fax number, or e-mail.

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From the editor of this issue

This issue Veterinární Medicína has been composed of full texts and abstracts of papers presented at the international colloquium "Environmental Factors Affecting Fertility" held on 25th June 1998 in Brno on the occasion of 70th birthday of Prof. MVDr. Zdeněk Věžník, DrSc. The manuscripts have not been edited according to instructions for authors publishing in this journal, and have not been reviewed by referees as it is usual in other manuscripts. However, they were subject to criticism and were discussed at the colloquium. The authors of the manuscripts are responsible for the linguistic aspects of their manuscripts. This comment is to explain the rather atypical character of this issue.