Iodine Deficiency Disorders and Iodized Salt for Livestock

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1. INTRODUCTION

It is now well appreciated that Iodine Deficiency Disorders (IDD) are major public health problems in the world affecting large populations in over 110 countries with nearly 1.6 billion people at risk. What is not well known is the severe effect of iodine deficiency on animals. Farm animals are equally at risk to the spectrum of IDD at all stages of growth and development from conception to physical performance.

Unlike other nutrients such as iron calcium or the vitamins, iodine does not occur naturally in specific foods; rather, it is present in the soil and imbibed through foods grown on that soil. Iodine is irregularly distributed over the earth's crust resulting in acute deficiencies in areas like mountainous regions and flooded riverines. The problem is aggravated by accelerated deforestation and soil erosion. This deficiency cannot be corrected. The food grown in iodine deficient regions can never provide enough iodine to the population and livestock living there. There are indeed rare examples of foods rich in iodine such as certain types of sea weed and sea fish; but these are not accessible to everyone. Thus, iodine deficiency results from geological rather than social and economic conditions. It cannot be eliminated by changing dietary habits or by eating specific kinds of foods. Rather the correction has to be achieved by supplying iodine form as an external source.

2. EFFECT OF IODINE DEFICIENCY IN FARM ANIMALS

Reproductive failure is often the outstanding manifestation of iodine deficiency and consequent impairment of thyroid activity in farm animals (Hetzel and Maberly, 1986). The birth of weak, dead, or hairless young in breeding stock has long been recognized in goitrous areas. Foetal development may be arrested at any stage, leading to either early death and resorption, abortion and stillbirth, or the live birth of weak young ones. Specific effects of iodine deficiency on different animals are subsequently discussed.

2.1. Goat and Sheep

The influence of iodine supply on the reproduction of goats-success of conception, success of first insemination, abortion rate in gravid goats, length of gravidity, kids per gravid goat, and kids carried to term per gravid goat are in Table - 1. For example, the abortion rate in iodine deficient goats is 47 per cent as compared to 0 per cent in the iodine sufficient goats. More kids are born to iodine sufficient goats and the probability of survival of kids born to iodine sufficient goats twice those that are born to iodine deficient goats. Similar results have been reported in sheep.

The symptoms of iodine deficiency in mature sheep are goitre, reduced yield of wool, reduced conception rate, or lambs born weak, dead, or without wool.

2.2. Beef and dairy cattle

Birth of calves with goitre is a sign of borderline or definite iodine deficiency although cows may appear normal and yet be afflicted. Iodine deficient calves may also be born blind, hairless, weak, or dead depending on the severity of the deficiency. Long-term deficiencies may result in decreased milk yields. In addition, irregular or suppressed estrus in dairy cattle causing infertility has been associated with goitre and shown to respond to iodine therapy. Work done by scientists in iodine deficient areas of Finland and Canada has demonstrated a marked improvement in

the first service conception rate by feeding organic iodine preparations, beginning 8-10 days before the cows came into oestrus. Iodine deficiency is also known to cause male infertility (in bulls and stallions).

2.3. Horses

Pregnant mares may not show external signs of iodine deficiency but may produce a stillborn foal or one showing extreme weakness at birth. Foals born alive with a well developed goitre usually die or remain weak for the duration of their life.

2.4. Pigs

Piglets born to iodine deficient sows have thickened skin, puffy necks, hairlessness, and bloated appearance. Some piglets are born dead, while those born alive are weak and usually die within a few hours.

2.5. Poultry

Iodine deficiency in breeding hens results in reduced egg production, decreased hatchability, prolonged hatching time and thyroid enlargement in the embryos (March et al. 1984).

3. ECONOMIC BENEFITS OF IODINE SUPPLEMENTATION TO ANIMALS

Consumption of iodine by farm animals adds to their economic productivity. Adding trace minerals (iodine, copper, iron, cobalt, selenium, zinc and manganese) to animal diets benefits animal productivity. A study done at Purdue University with growing pigs showed that adding a trace mineral mixture to the diet improved gains by 15.4 per cent compared to the controls fed no trace minerals (Conrad etal. 1959). Another study showed that the cost of trace minerals was 4.7 US cents per pig but returned $1.64 US (a cost benefit ratio of 1:35). A study in Colombia indicated a return of 15.6 Pesos for each Peso invested in mineral supplements for animals compared to common salt supplements only.

The cost benefit ratio of iodine supplementation will be significant making the program a worthwhile investment, not only for the farm sector, but also for better human resource development.

3.1. Salt for animals

Both sodium and chlorine are necessary elements for animal life. In earlier times, the provision of salt in the rations of farm animals was haphazard, resulting in inefficient production (Bell, 1960). A continuously low salt intake affects the health of animals through loss of appetite and weight. Feed utilization decreases and more feed per unit of gain is required. In recent years, the role of common salt in animal feeding and nutrition has received increased attention. Salt is also a natural carrier for trace minerals since all animals need salt. Moreover, when cattle, horses, sheep and other animals graze on pasture with little, none, or

Table 1
Influence of iodine supply on the reproduction of goats

Description	Iodine content of dry matter in the feed (mg/kg)	
	0.04 (n=19)	0.40 (n=18)
Success of conception (%)	79	83
Success of first insemination (%)	27	73
Abortion rate of gravid goats (%)	47	0
Length of gravidity (days)	158	152
Kids per gravid goat	1.4	1.7
Kids carried to term per gravid goat	0.9	1.7

varying amounts of concentrate feeding, farmers can always supply trace mineralized salt in a mineral block or box with free access, although this can lead to overconsumption of salt.

3.2. Salt as a carrier of nutrients

In the rural areas of many developing countries where iodine deficiency is most severe, people are largely dependent on subsistence foods. Their staple diet typically consists of one or two cereals can tubers or pulses. If a household has any livestock, dairy products may also be consumed. It is in this economic and dietary context that the choice of a vehicle for iodine must be considered.

Over the past 60 years, efforts to introduce iodine regularly in the daily diet have considered several foods as possible vehicles. Among these, salt has become the most commonly accepted, for a variety of reasons.

1) Salt is one of the few commodities that comes closest to being universally consumed by almost all sections of a community irrespective of economic status. It is consumed at approximately the same level throughout the year in a given region by all normal adults. Thus, a micronutrient like iodine when introduced through salt can be administered to each individual at a uniform dosage throughout the year.

2) Compared to other food commodities whose production is widely dispersed, the production of salt is limited to fewer production centres. In many remote areas of the world, salt is one of the few commodities that comes from outside the local area, thereby lending itself to processing on an economical scale and under controlled conditions. By adding a fixed dosage of a micronutrient like iodine to salt at centralized locations, a majority of the population and livestock all over a region or country can ingest the nutrient with minimal effort of supplementation.

3) The mixing of an iodine compound with salt is a simple operation and produces no adverse chemical reactions. The equipment required is uncomplicated and easy to operate and maintain.

4) The addition of iodine to salt (usually as potassium or sodium iodide/iodate) does no impart any colour, taste or odour to the salt. In fact, iodized salt is indistinguishable from uniodized salt.

5) The cost of iodization is low; normally in the range 2-7 US cents per kilogram, which is less than 5 percent of the retail price of salt in most countries.

Salt iodization is the long term and sustainable solution that will ensure that iodine reaches the entire population and is ingested on a regular basis. Once the iodization of salt is established as permanent measure in a country, it eliminates iodine deficiency disorders and continues to provide each individual with a daily dose of iodine to prevent any recurrence. The introduction of iodine through salt has been successful in eliminating the problem of iodine deficiency in several countries for over 60 years. Since iodine is required in very minute quantities (150-200 micrograms), dosage in salt is extremely small. Salt consumption could be anywhere in the range of 5-20 grams a day within a given region or country. Normally, iodine concentration of salt is fixed in the range of 30 - 100 micrograms of iodine per gram of salt. This dosage takes into account anticipated iodine losses during transportation and storage.

3.3. Iodine supplementation for farm animals

In the developed countries, iodine supplementation had greatly reduced the incidence of IDD in both humans and animals. Reports from Montana, USA, indicate that before iodine feeding was practised there, goitre has caused an annual loss of thousands of pigs. Records from other areas show serious losses in the sheep and cattle industries prior to the discovery of the lack of iodine as the causative factor (McDowell, 1992)

Salt is the predominant vehicle for providing supplemental iodine for farm animals, Supplemental iodine may be incorporated into the salt, mineral mixture or concentrate feeds. For grazing animals in some inaccessible parts of the world, iodized salt blocks are air dropped. Salt iodized with either iodide

and iodate are equally available to livestock. EIDD is an organic iodide used at relatively high dosages for the treatment of foot rot, lumpy jaw, and other conditions.

3.4. Iodine levels in salt for animals

In the developed countries, there are a range of trace mineralized salts that cater to each variety of livestock and poultry. In these trace mineralized salts, typically for livestock, levels of 70-80 ppm iodine are used. Organized livestock rearing is a growing industry but is still limited. Farmers buy one type of salt from the market for both their livestock and their family.

Estimates of iodine levels in salt for different animals is presented in table 14.2. From this table, it can be seen that the iodine levels in salt varies over a wide range (i.e., 30-40 ppm) and is species dependent. Minimum salt requirements for many categories of livestock can be ensured if the level of iodine in salt is approximately at least 20 ppm at the consumer level. If cattle and sheep continue to demonstrate iodine deficiency, then additional iodine supplementation may be required through cattle feeds or other sources. In all cases, however, there is no risk of toxicity to any class of animals, even with salt containing high levels of iodine of 200 ppm.

4. IMPLICATIONS FOR THE UNIVERSAL SALT IODIZATION (USI) PROGRAMME

There is now a global thrust to eliminate iodine deficiency in humans through universal salt iodization (USI). A mid-decade goal of USI has been set for the end of 1995. Iodization programmes are already under way in over 60 countries. In order to have effective salt iodization programmes, all salt required for human and animal consumption must be iodized. If salt for human consumption is only iodized, then there exist a situation in the market where non-iodized salt, which is cheaper than iodized salt, is available for animal consumption. This leads people to purchase the cheaper, non-iodized salt. The availability of two types of salt also poses a major problem to law enforcing agencies as they cannot take legal action against those selling non-iodized salt since it is intended for animal consumption. In addition to issues of implementation, it is relevant to state here that farm animals are at equal risk of IDD as they reside in the same iodine deficient areas as humans.

Table 2

Iodine requirements of animals

Class of Animal	Iodine Requirement in total Diet (ppm)	Maximum Dietary Tolerance Levels (ppm)	Salt Consumption (kg/year)	Iodine Required in salt (ppm)
Swine	0.14	400	4.1	28
Beef cattle	0.2-2.0	50	10	40-400
Dairy cattle	0.25-0.50	50	24.3	50-100
Horses	0.1	5	10.9	20
Sheep	0.1-0.8	50	4.1	20-160
Goats	0.15-0.80	50	4-8	30-240
Poultry	0.3-0.4	300	0.2	120-160

Source : *Cunha, T.J. Salt and Trace Minerals for Livestock, Poultry and Other Animals. The Salt Institute: Alexandria, Virginia, U.S.A. 1987.*

5. RECOMMENDATIONS

1. Legislation covering the iodization of salt for human use should be extended to include all salt for livestock consumption. This will have the double benefit of ensuring that animals receive iodine supplementation and also that there is only one variety of salt in the market (iodized salt).

2. Advocacy and publicity campaigns should stress the need for iodine in animals and highlight the benefits of an iodine supplementation programme.

3. In many countries, it is very difficult to have separate grades of iodized salt for animals. Therefore, a separate monitoring of iodine intake of animals will be necessary to determine if certain categories require additional supplementation through feeds, etc.

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