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Exotic protein sources to meet all needs☆

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ABSTRACT

Venison from farmed deer has by now become common on the market. This follows the application of animal husbandry techniques to ensure a controlled supply of quality meat. Numerous studies discussed in this presentation have elucidated some of the factors that influence the meat composition and quality derived from various deer species. On the other hand, meat from wild, free-roaming animals has not yet reached a similar position in the industry and in the mind of the consumer. Yet these species show great potential, especially as pertaining to their meat production when discussed under the global warming scenario. In particular, the rodent species that are currently utilized in the bushmeat trade show potential for meat production. This presentation will endeavor to discuss the positive and negative aspects of these species as potential meat sources.

1. Introduction

Most modern food producers are now well aware of the projected growth in the global human population, estimated to reach 8.1–10.5 billion by the year 2050 (United Nations Department of Economic and Social Affairs, 2011). Food producers are also cognizant of the challenges faced in feeding this escalating population and have been increasingly exploring and applying biotechnologies such as genetic modification (GM) to improve the yields of crops that are utilized for feeding both humans and livestock (Aiking, 2011; Wang & Brummer, 2012).

Within the traditionally-farmed livestock sector (cattle, sheep, goats, pigs and poultry), producers have begun to apply precision-farming techniques that include accurate record keeping of animals and their performance, as well as pasture management strategies. In the dairy industry, for example, the use of artificial insemination (AI) has aided in improving production tremendously. The use of this technique has been far more limited in beef farming thus far, although Brazil has started using it in extensive production systems (Millen, Pacheco, Meyer, Rodrigues, & Arrigon, 2011).

Through the use of AI, it becomes possible for farmers to use genetics from breeds not available in their country and/or from animals with very high performance that have been extensively assessed through progeny testing. The use of sexed sperm may also have potential, especially in consideration of the fact that bulls produce leaner carcasses and have more efficient growth rates (Garnera & Seidel, 2008). Unfortunately there are still obstacles to the use of assisted reproductive techniques in beef cattle. The use of synchronized mating has now become common practice in the sheep industry, even in extensive systems where, combined with laparoscopy, higher lambing percentages have been noted.

In terms of pasture management, by regularly measuring and observing the condition of the pastures, as well as making use of planned rotational grazing systems, farmers are able to increase their output in the long- and short-term. They are also able to accurately calculate the available dry material as well as predict how much will be required in the future. This will allow farmers to make provisions for droughts by planting fodder species for conserved feed or leaving pastures open to act as drought reserves. The latter is especially applicable within the context of the impending global warming scenario, which is expected to result in extreme weather patterns. The topic of pastoralism and the challenges posed by global warming have been discussed by Krätli, Huelsebusch, Brooks, and Kaufmann (2013) and Wheeler and Reynolds (2013).

One strategy that has been employed to increase meat protein output is to intensify the production system, which is particularly applicable to monogastric animals (pigs and poultry), but is also common in industrialized countries for beef and to a lesser extent, sheep. The foci of these systems are to improve production efficiency, which encompasses the improvement of the average daily gain and the feed conversion rate. Although growth stimulants/hormones and antibiotics are also frequently used to improve production efficiency, there is often resistance on the part of consumers with regards to the use of growth enhancers, as well as to the general idea of intensive or 'factory' farming as

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it is commonly referred to (Napolitano, Girolami, & Braghieri, 2010). There has also been growing consumer concern on the pollution, carbon footprint and water footprint associated with these systems, with the latter especially causing apprehension when the water used to produce cereals and fodder for animal feed is taken into account (Aiking, 2011). A question that has also been posed of late is whether it is ethically acceptable to feed plant protein sources suitable for human consumption to animals? A further concern is the increasing competition by the biofuel industry for the same energy sources (crops and cereals) that are commonly used for animal feed. However, there is an ongoing debate amongst researchers and producers regarding the pollution and carbon footprints of intensive versus extensive farming production systems (see for example the presentation by J.L. Capper, 2011: http://www.academia.edu/1697358/The_carbon_Footprint_of_Beef_Production) while at the same time researchers cannot decide on which system is better (see review by Muir, Deaker, & Bown, 1998).

Nonetheless, the reality accepted by many livestock producers is the fact that 26% (3.38 billion hectares) of the surface area of the earth is not suitable for any crop production and is only suitable for livestock (predominantly ruminant) production (Ramankutty, Evan, Monfreda, & Foley, 2008). Desertification and global warming are decreasing this area very rapidly. This phenomenon has prompted animal scientists to revisit and test the suitability for protein production of certain indigenous species that have adapted over time to survive extreme conditions, examples of which include reindeer in Alaska and Northern Europe, ungulates in Africa, and kangaroos in Australia (Hoffman & Cawthorn, 2012). A further strategy, particularly in the developing world, has been to promote the farming or harvesting of those species which are abundant, including agricultural pests, which could represent valuable food sources (Hoffman & Cawthorn, 2012; Jori, Lopez-Beajar, & Houben, 1998; Jori, Mensah, & Adjanohoun, 1995). The farming of these smaller species has been named micro-livestock production (National Research Council, 1991). However, as numerous scientists have cautioned, the farming of these micro-livestock species, which are predominately rodents, should only be conducted in regions where they occur naturally. The reason for this lies in the fact that agricultural pests can become invasive very rapidly, as has been seen, for instance, with the spreading of nutria or coypu (*Myocastor coypus*) – a herbivorous rodent native to Argentina, Chile and Uruguay – into the USA, Europe and China (Lowe, Browne, Boudjelas, & De Poorter, 2000). In China, this species was first introduced from the former Union of Soviet Socialist Republics (USSR) to the Northeast China Zoo for display. Since 1986, nutria has been bred and raised in large numbers in many areas, especially in southern China, because of its heavy, soft, fine fur. However, a market for nutria failed to develop, mainly due to the high cost of young animals, poor fur quality and unpalatable meat. By the mid-1990s, nutria farming was largely abandoned and without management and control, nutria was released or this escaped. Many subsequently established wild populations, which are causing increasing damage to fruit trees and crops. The species is now regarded as a significant pest in orchards and crop lands (Yan, Zhenyu, Gregg, & Dianmo, 2001).

Most indigenous animal species do well in terms of productivity when they are farmed under favorable conditions (as opposed to their productivity under extreme conditions), making it questionable as to why these species are not more successful. Understandably, it is possible that these species are successful in their own rights, but their products (predominantly meat) do not readily enter the formal meat sector and are thus not taken into account. A typical case of this would be the large number of rodent species that are traded as bushmeat in the informal markets throughout Africa. For instance, it is estimated that the total harvest of the latter species is upward of six million tons per year in the Congo basin alone (this is about 60% of the 9–10 million metric tons of beef production of Brazil) (van Vliet, Nebesse, Gambalemoke, Akaibe, & Nasi, 2012). The political instability frequently found in African countries also increases the consumption of bushmeat as a protein source, as shown in Zimbabwe (Lindsey, Romañach, Tambling, Chartier, & Groom, 2011). Bushmeat consumption and trading are also practiced in South America, where the hunting of feral pig (*Sus scrofa*), for example, is now a major source of income and protein in the Brazilian Pantanal (Desbiez, Piovezan, & Bodmer, 2011). The economic value of this informal trade is very difficult to quantify in developing economies, although it has been shown to contribute substantially to the economy in Britain (MacMillan & Phillip, 2008).

The farming of a number of game species, such as deer and ostriches, has grown considerably in the past fifty years. Although not all these species are considered tame, there is some argument that some of the latter animals have become domesticated in the sense that the farmer often decides which animals will be bred with, what feed will be fed (Volpelli, Valusso, & Piasentier, 2002; Webster, Corson, & Littlejohn, 2001) and which animals will be slaughtered (Hoffman & Cawthorn, 2012; Mysterud, 2010). One of the major reasons for the increased farming of these species is due to the demand for their meat, fuelled largely by health conscious consumers who are aware of the leanness of the flesh in comparison to that from conventional livestock species. Another driver for the consumption of these "exotic" meat types is driven by a better educated, younger consumer who wishes to try new adventurous foods as part of the organoleptic experience. Typically, many tourists to Africa wish to eat local wild species, ranging from springbok to crocodile as part of the "Africa experience" (Hoffman, Crafford, Muller, & Schutte, 2003). Further, the fact that the world has become a large global village has resulted in numerous consumers wishing to taste their traditional meat (food) even when they are away from home. This is evident from the vast array of species confiscated annually at all the major airports, especially on flights out of Africa. Concerns have been raised about the illegal import of bushmeat from Africa into Europe, particularly as relating to the health risks posed to people and livestock. The size of this illegal trade is not precisely known, but it has been estimated that around five tons of bushmeat per week (273 tons per annum) is smuggled in personal baggage through Paris Roissy-Charles de Gaulle airport (Chaber, Allebone-Webb, Lignereux, Cunningham, & Rowcliffe, 2010). Bushmeat is not only imported for personal consumption, but is part of a lucrative organized trade, with high prices indicating luxury status. A wide range of species is transported or carried on as hand luggage, many of which are CITES-listed (Convention on International Trade in Endangered Species of Wild Fauna and Flora: CITES, www.cites.org). The latter is especially worrisome as it is highly questionable whether this is done on a sustainable basis.

For most species to become successful in terms of commercial production, a number of traits are required for them to compete with domestic livestock. Domesticated meat species have been selected for generations for enhanced production parameters, including increased reproductive fitness (the litter size of the domestic pig has increased from 8 to 14 piglets weaned), genetic selection for faster growth rates and feed conversion ratios, as well as the culling of animals to ensure a shorter number of empty days period. Production efficiency has been improved further through understanding the entire digestive process and developing diets that are more efficiently converted into body mass. The domestic animal populations have become more homogenized – this is an advantage for intensive slaughter and processing lines – which in turn opens the way for mechanization and the use of robotics. Then of course, there has to be consumer acceptance of the meat — as shown early in 2013 by the consumer aversion towards horse meat in the United Kingdom, yet horse meat is readily consumed in other countries.

Wild animals that give birth to single offspring (monoparous) are perceived to be less productive than farmed species. However, in farmed species the young are typically removed (and slaughtered) soon after weaning, while in wild animals, mature and frequently

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