Livestock Production to Feed the Planet

Animal Protein: a Forecast of Global Demand over the Next Years

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ABSTRACT

The world population will significantly increase by 2050, from the current seven million to more than nine million inhabitants and the highest rate of increase is expected in developing countries. The demand for animal products will follow the population growth and increase between 50 and 70%, although with differences between all regions. According nutritional recommendations, at least one third of the daily protein requirement should derived from animal proteins. Meat, fish, milk or eggs, rich essential amino acids, micronutrients and vitamins, should provide about 20g of 60g of total protein; however, the current level of intake should be reduced. In the next future, livestock sector will increase the productivity, without compromising the quality and the nutritional safety of the products, as well as the environmental protection and animal welfare. Considering the future population growth and the future food demand, different environmental implications on land use, natural non-renewable resources such as water, fossil fuels, minerals and agricultural land, and on the greenhouse gases (GHG) emissions should also be taken into consideration. Farming edible insect could be a possible solution to overcome the future population growth, the global demand for food, specifically for protein sources and the food waste reduction.

Keywords: population growth, protein requirements, animal products, bioactive components, nutritional safety, welfare, livestock nutrition, environmental impact, food waste, insects.

1. Introduction

The Food and Agriculture Organization (FAO) has estimated that the world population will significantly increase by 2050, from the current seven million to more than nine million inhabitants. The developed countries will present a moderate growth; while the highest rate of increase is expected in developing countries. As well as the population growth, the demand for animal products will present an increase between 50 and 70% from the current production level; however, this growth will not be uniform between all regions. In developed countries, after the sharp increase in food consumption in the post-war period, there was a slowdown in the consumption of animal protein, with particular regard to red meat and nowadays the market has reached a state of maturity and saturation (European Union 2015).

The context of the developed countries strongly contrasts with that of the developing ones. In these areas today's food consumption has changed a lot compared to the past; population and income growth, as well as urbanization, have led to a steady increase in per capita consumption of animal products and it is estimated a constant increase in the coming years (Baldi et al. 2016). Different trends for the various foodstuffs are expected over the next decade for meat products, with a general increase in consumption in fast-growing countries at or above 10% (FAO 2011; Alexandratos and Bruinsma 2012) and even more pronounced for milk and dairy products (see *fig. 1*).

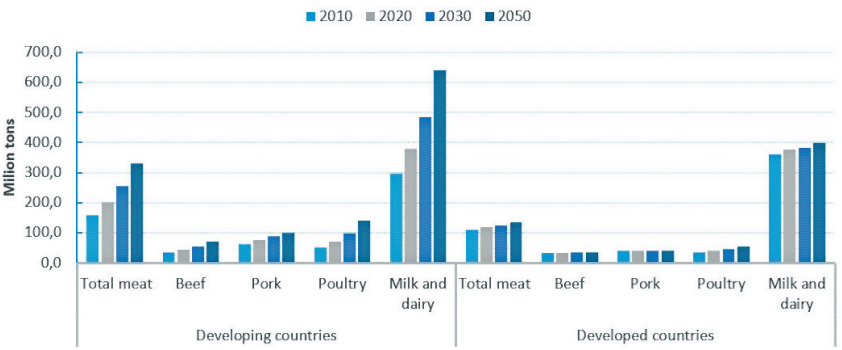

Figure 1. – Forecast of the consumption of animal products (modified from Report FAO 2011).

It is extremely important to emphasize that many countries in the world are still malnourished and their diet is not able to fulfil their actual requirements. Nutritional recommendations regarding the protein intakes suggest that at least one third of the daily protein requirement, which corresponds to 0.66-1g per kg of body weight depending on age, sex and physical activity, should come from animal proteins (World Health Organization 2002). As a result, about 20g of 60g of total protein should derive from meat, fish, milk or eggs; however, this data is lower than the current overall level of intake, which is around 24g per day.

Meat, fish, eggs, milk and dairy products provide high biological value protein, characterized by the presence of essential amino acids, such as methionine, cysteine and lysine, crucial for correct growth and body function. These foods sources also contain micro-nutrients, such as iron, zinc, vitamin A, vitamin B12 and calcium, in addition to some "bio-active" components, among which the milk protein derived are the most studied. Therefore, the consumption of animal products, together with a varied and balanced diet, is crucial for all age groups, especially children, athletes, pregnant and breastfeeding women and elderly. All animal products are characterized by nutrients high bioavailability as well as their approval rate; for this reason, these foods are also considered indicators of life quality in many regions of the world. Consuming animal products, especially meat, is not only a reflection of nutritional needs, but it is also justified by sensory, geographical, cultural, ethical and economic well-being choices.

In many areas, especially in the developing countries, the increase in the consumption of animal products is affected by the change in eating habits and in particular by the Western lifestyle influence. In Italy these amounts are abundantly respected thanks to the adherence to the Mediterranean diet, which provides a regular consumption of fish products and vegetable protein sources, like pulses, but also a strong variation in food choice, with the preference of whole grains, seasonal fruits and vegetables and local and high-quality raw materials.

2. Future challenges

In light of the above, the future challenge that livestock production will be expected to overcome in the next years will consist in increasing the productivity, without compromising the quality and the nutritional safety of the products, the environmental protection and animal welfare. Animal welfare is now considered a prerequisite for livestock sector, which must follow stringent and precise guidelines concerning animal management

conditions. Thanks to the close correlation between well-being, health and food-borne diseases, animal welfare affects indirectly the safety of the food chain and eventually human's health. Livestock welfare widely depends by human management practices, such as the type of facilities, stocking density, transport conditions and stunning methods (EFSA 2013).

Over the years, many definitions of animal welfare have been given, but the one that is considered the most complete and comprehensive belongs to Broom (1986): "the welfare of an individual is its state in relation to its attempts to adapt to the environment". Even before, in 1965 was published the Brambell Report that is considered the most influent paper for the animal welfare assessment where the five freedoms for the protection of animals are stated:

1. Freedom from hunger, thirst and malnutrition.
2. Freedom from discomfort.
3. Freedom from pain, diseases and injuries.
4. Freedom to express normal behaviour.
5. Freedom from fear and stress.

Today, compared to the past, animal welfare is considered a multidisciplinary and more complex concept. For this reasons, the application of the five freedoms for the evaluation of animal welfare has been replaced by the use of the 4 principles and 12 criteria, reported in *Figure 2* (Canali 2015).

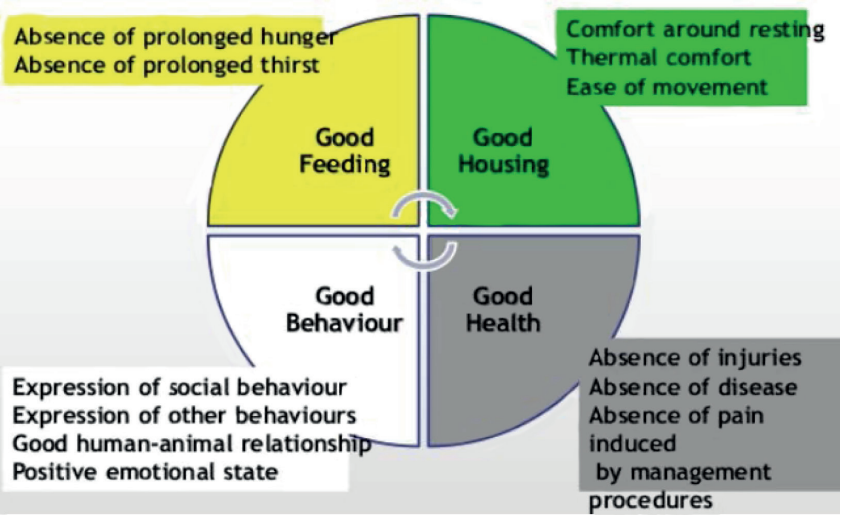

Figure 2. – Scheme of the 4 principles and 12 criteria.

It is possible to notice that the fulfilment of the food requirements represents the first condition for the protection of animal welfare. In fact, a correct diet not only must prevent the occurrence of malnutrition or food shortages, but plays also a significant role in the general state of health. Nutrition must meet the physiological needs at different stages of growth, promote and maximize the different livestock production, optimize fertility and reproductive efficiency and finally ensure an optimal health of the animals with particular reference to the immune and antioxidants defences.

The selection and processing of raw materials, the formulation of specific diets, the use of additives and supplementations as well as their administration method may have a great impact on the dietary and nutritional value, on the sensory quality of the meat, on the environmental impact and thus on food waste. For instance, the administration of flax seeds to beef cattle during the finishing stage allows to increase the polyunsaturated fatty acids (PUFA) concentration, and in particular the α-linolenic acid, in the intramuscular fat, reducing significantly the ω6 / ω3 ratio in the meat (Alberti et al. 2014). Thanks to the inclusion of vitamin E and selenium in animal diet, it is also possible to increase the oxidative stability of the meat, extend the shelf life and preserve the organoleptic and nutritional characteristics, as well as enhance the immune response of the animals (Baldi 2005; Lu et al. 2014).

Considering the global scenario, the future population growth, combined with the future food demand, will have different environmental implications on land use, natural non-renewable resources such as water, fossil fuels, minerals and agricultural land, and on the greenhouse gases (GHG) emissions. As FAO reported in 2012, the trend of GHG global emissions in the agricultural sector has been steadily increasing over the last fifty years (2.7 billion tons CO2 eq in 1961 vs. 5.3 billion tons CO2 eq in 2010). Livestock sector is responsible for 15% of the total emissions of CH4, CO2 and N2O, although the different farming systems affect different emissions levels.

In particular, broilers farming has the lower atmospheric emissions (612 million tonnes CO2 eq); on the other hand, rearing beef cattle appears to be the most impactful livestock sector (2.5 billion tons CO2 eq). The presence of the rumen and the symbiont microflora reduces the food efficiency and increases the methane emissions as a product of rumen fermentation. Therefore, atmospheric emissions, together with water consumption and wastewater management, represent the main issue about the ruminant livestock sustainability. Although the large number of intensive farms present in the developed countries, the major GHG emissions come from the developing regions, characterized by a low production efficiency. The low

feed-to-food efficiency leads to greater difficulty in reducing the emissions; in fact, according to FAO report, in 2010 the major Asian countries were responsible for 44% of total emissions (FAO 2014).

3. Conclusions

If we consider the global scenario of the livestock products, a timely issue is represented also by food waste; today one third of the food produced for human consumption, about 1.3 billion tonnes per year, is lost or wasted throughout the supply chain (FAO 2011). So far, animal nutrition encourages the use of by-products, such as distillers, sugar beet pulp and soy hulls, as a source of nutrients for farmed animals. More recently, nutritional research is going towards the use of alternative products, such as unsold or defective snacks, which retain excellent nutritional characteristics. Such foods must be properly controlled and processed, but can find space in livestock production. Farming edible insect could be a possible way to overcome the future population growth, the global demand for food, specifically animal protein sources, and the food waste reduction.

Insects live everywhere and reproduce quickly, have a high growth rate and feed conversion ratio (about 4 times higher than cattle) and moreover a low environmental impact throughout their life cycle; for example pigs produce 10-100 times more greenhouse gases per kg of weight than mealworms. They are nutritious, rich in protein (around 13-28g/100g total), fat and minerals and can be reared on food waste. They can also be consumed whole or ground into powders or pastes and incorporated in other types of food. For example, the use of insects as feed for aquaculture and poultry will become increasingly common in the next decade (Van Huis et al. 2013).

References

Albertí, Pere, Maria José Beriain, Guillermo Ripoll, Victoria Sarriés, Begona Panea, Juan Alvarez Mendizabal, Antonio Purroy, José Luis Olleta, and Carlos Sañudo. 2014. "Effect of Including Linseed in a Concentrate Fed to Young Bulls on Intramuscular Fatty Acids and Beef Color". *Meat Science* 96 (3): 1258-65.

Alexandratos, Nikos, and Jelle Bruinsma. 2012. *World Agriculture towards 2030/2050: the 2012 Revision*. ESA Working Paper 12-03. Roma: Food and Agriculture Organization of the United Nations (FAO).

Baldi, Antonella. 2005. "Vitamin E in Dairy Cows". *Livestock Production Science* 98 (1-2): 117-22.

Baldi, Antonella, Davide Gottardo, and Carlotta Giromini. 2016. "Proteine animali. Una previsione della domanda globale nei prossimi 20 anni". *NutriMI. La Rivista di Nutrizione Pratica* 10: 20-1.

Broom, Donald Maurice. 1986. "Indicators of Poor Welfare". *British Veterinary Journal* 142: 524-6.

Canali, Elisabetta. 2015. *Convegno Food and Feed for Wellbeing per EXPO Milano 2015*.

EFSA. 2013. *Benessere degli animali*. https://www.efsa.europa.eu/it/topics/topic/animalwelfare.

European Union. 2015. "Price Developments and Links to Food Security: Price Level and Volatility". *EU Agricultural Markets Briefs* 6 (June). http://ec.europa.eu/agriculture/markets-and-prices/market-briefs/pdf/05_en.pdf.

FAO (Food and Agriculture Organization of the United Nations). 2011. *World Livestock 2011 – Livestock in Food Security. Rome*. http://reliefweb.int/sites/reliefweb.int/files/resources/Full%20Report_421.pdf.

——— 2014. *Greenhouse Gas Emissions from Agriculture, Forestry and Other Land Use*. http://www.fao.org/assets/infographics/FAO-Infographic-GHG-en.pdf.

Gerber, Pierre J., Henning Steinfeld, Benjamin Henderson, Anne Mottet, Carolyn Opio, Jeroen Dijkman, Alessandra Falcucci, and Giuseppe Tempio. 2013. *Tackling Climate Change through Livestock: a Global Assessment of Emissions and Mitigation Opportunities*. Roma: Food and Agriculture Organization of the United Nations (FAO).

Lu, Ting, Allen F. Harper, Junmei Zhao, Benjamin A. Corl, Tanya LeRoith, and Rami Dalloul. 2014. "Effects of a Dietary Antioxidant Blend and Vitamin E on Fatty Acid Profile, Liver Function, and Inflammatory Response in Broiler Chickens Fed a Diet High in Oxidants". *Poultry Science* 93 (7): 1658-66.

Van Huis, Arnold, Joost Van Itterbeeck, Harmke Klunder, Esther Mertens, Afton Halloran, Giulia Muir, and Paul Vantomme. 2013. *Edible Insects: Future Prospects for Food and Feed Security*. FAO Forestry Paper 171. Roma: Food and Agriculture Organization of the United Nations (FAO).

World Health Organization. 2002. *Protein and Amino Acid Requirements in Human Nutrition. Report of a Joint WHO/FAO/UNU Expert Consultation*. WHO Technical Report Series 935.