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Research Article – Dossier Open Access

Protein sources in animal feed
Les sources de protéines dans l'alimentation du bétail

What is the way forward for protein supply? The European perspective

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Abstract – This article provides a description of the current European situation regarding protein supply. It calls for a more accurate assessment of the contribution of domestic feed materials to the EU protein balance sheet, in particular cereals. The article then looks at various options to improve the EU protein balance sheet and analyses the consequences of main EU policies in that regard, such as the Common Agricultural Policy and the EU biofuels policy. The last part of the article deals with the possibility to reduce protein consumption by the EU feed industry, by further increase of feed efficiency. Taking into account the need for the EU feed and livestock industries to remain competitive on a global market, as well as the strategic dimension of the EU protein deficit, this article calls for a pragmatic approach and recommends facilitating access to existing sources of vegetable proteins as a first step to improve the EU protein supply. The article also underlines the importance of research and development to improve the competiveness of EU protein crops, therefore reducing the need for public support.

Keywords: European protein supply / European protein deficit / European protein balance sheet / EU feed industry / competitiveness / Common Agricultural Policy / pragmatic approach

Résumé – Quelle voie à suivre pour l'approvisionnement en protéines ? La perspectives européenne. Cet article décrit la situation actuelle de l'approvisionnement européen en protéines. Il appelle à une évaluation plus fine de la contribution des matières premières européennes au bilan protéique européen, en particulier en ce qui concerne les céréales. L'article examine ensuite les différentes options permettant d'améliorer le bilan protéique européen et analyse les conséquences des principales politiques européennes ayant une influence sur ce bilan telles que la Politique Agricole Commune et la politique européenne relative aux agro-carburants. La dernière partie de l'article traite de la possibilité de réduire la consommation de protéines par l'industrie européenne la nutrition animale, en continuant à améliorer l'efficacité nutritionnelle. Prenant en compte la nécessité pour l'industrie européenne de la nutrition animale de rester compétitive ainsi que la dimension stratégique du déficit protéique européen, l'article recommande une approche pragmatique consistant à faciliter l'accès aux sources de protéines végétales existantes, comme première étape pour améliorer l'approvisionnement européen en protéines. L'article souligne aussi l'importance de la recherche et développement pour améliorer la compétitivité des protéines végétales européennes, réduisant ainsi le besoin de soutien public.

Mots clés : Approvisionnement européen en protéines / déficit protéique européen / bilan protéique européen / industrie européenne de la nutrition animale / Politique agricole Commune / approche pragmatique

Introduction

The debate around the European protein supply and the European protein deficit is attracting more and more attention. Although the EU protein deficit is not something new, the growing global demand for animal products, the limited availability of natural resources, such as land and water, bring new perspectives to the debate. The first section of this article will attempt to describe the current situation regarding the European protein supply, focusing on the strategic dimension which is often neglected in the public debate. The second section will try to analyse the different options which could be implemented in order to improve the EU protein balance sheet, from a European feed industry perspective.

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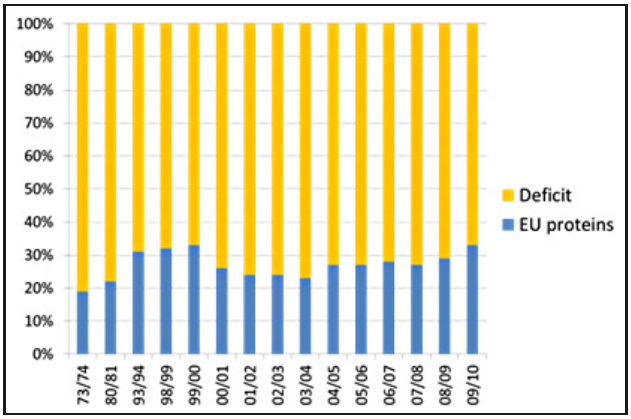

Fig. 1. Evolution of EU protein deficit (source: UNIP).

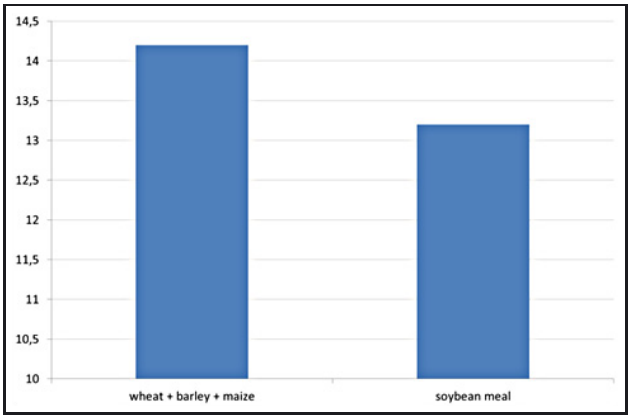

Fig. 2. Contribution of cereals and soybean meal to the EU protein supply in 2011 (million tonnes).

1 Current situation of the EU protein supply

1.1 EU protein deficit: what are we talking about?

When talking about the European protein deficit, 70% is a figure that is frequently mentioned, especially by the study "The environmental role of protein crops in the new common agricultural policy" recently published by the European Parliament. Figure 1 shows that this deficit has been fluctuating between 80% and 70% in the past forty years.

The protein-rich feed materials are considered to calculate this deficit, which is absolutely logic since the main reason for incorporating these ingredients in the feed diets is their contribution to meet the animals' nutritional requirements in terms of proteins. The contribution of cereals to the protein needs should however not be underestimated. According to the European Commission, 55.2 million tons of wheat, 36.1 million tons of barley and 54 million tons of maize have been used for feed (compound feed and home-mixing) in the 2011/2012 campaign. Considering the protein content of these cereals (11%, 10% and 8.5% for wheat, barley and maize, respectively), they provide approximately 14.2 million tons of protein equivalent. This is one million tons more than what was provided by soybean meal in 2011 (Fig. 2). According to FEDIOL, 29.4 million tonnes of soybean meal were used in 2011 in the European Union. Assuming a protein content

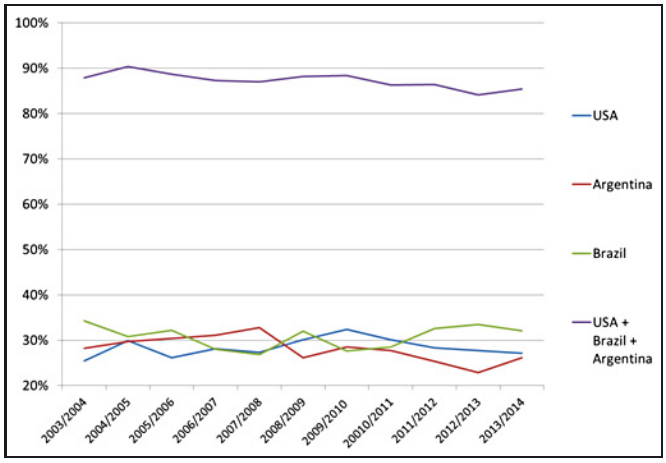

Fig. 3. Market share of the top 3 soybean countries in the global soybean trade, expressed in soybean meal equivalent (source: USDA). Figures color available at www.ocl-journal.org.

of 45%, this represents 13.2 million tonnes of protein equivalent. This is of course a very rough comparison[1] and the figures should be used carefully but it still shows that the contributions of EU cereals and of imported soybean to the European protein supply are of the same order of magnitude. This calls for a more sophisticated European balance sheet for proteins.

1.2 Strategic dimension of the EU protein deficit

The United States, Brazil and Argentina are the three main soybean producers, representing around 80% of the global soybean production. Their market share for exports (expressed in soybean equivalent) is even higher and has been fluctuating between 84% and 90% of the global soybean exports in the past 10 years (Fig. 3). From the perspective of the security of EU supply, it means that any problem in one of these countries will have immediate consequences on the global market and especially on the soybean meal prices. Due to adverse climatic conditions, this has been the case in 2012 in South America and in 2013 in the United States. The strategic consequences of this situation are amplified since the EU is no longer the main soybean buyer on the global market. Regarding soybean imports, China's market share has been indeed higher than the EU's for the last 5 years (see Fig. 4). In short, it means that the EU has very little control on its soybean supply. The development of alternative sources of protein becomes therefore of strategic importance.

1.3 What are the reasons for the EU protein deficit?

The EU deficit takes its roots in the 60s and persisted for geopolitical reasons via bilateral negotiations via the USA. With a slight but steady increasing demand for proteins in the EU, the relative stagnation of EU protein acreage was hardly compensated by yield improvements to maintain the EU protein deficit between 65 and 75%. The prohibition of

[1] Although small the contribution from imported cereals, if possible to calculate, should have been deducted since what is at stake is the protein deficit.

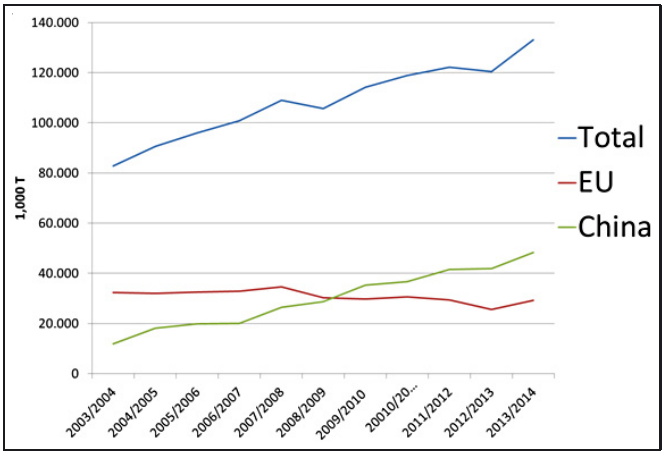

Fig. 4. Evolution of soybean meal equivalent imports (source: USDA).

processed animal proteins (so-called feed ban) in 2001 further worsened the EU protein dependency by 4%.

Protein crops are currently grown on 2% of arable land in the EU whereas they used to represent 4.7% of the arable land in 1961[2]. The protein crops, including oilseeds, are less protected than cereals from international competition. EU import duties for oilseeds were removed in 1962. It is also worth mentioning that a memorandum of understanding on oilseeds (so-called Blair House agreement) was concluded with the United States in 1992. This agreement set up limitations regarding EU support to oilseeds:

- limitation of supported area (no more than 5.482 million hectares);
- the quantity of co-products, expressed in soybean meal equivalent, made available through oilseeds for non-food purposes on subsidised set-aside land was capped to 1 million tonnes.

Interestingly enough, the CAP health check in 2008 abolished the specific payment for energy crops and the set-aside regime. This means that there are today no more limits on EU production of oilseeds, although the Blair House agreement is still in force.

The different crops compete for the same land and arable crop farmers base their decision on the economic output they can get from each crop. Applying this logic would lead to give preference to cereals in the farms rotation. This trend is strengthened by the comparative evolution of yields, which is very much in favour of wheat compared to protein crops. To compensate this competitive disadvantage, various supports targeted to oilseeds and protein crops were successively set up by the Common Agricultural Policy. Following the US embargo on soybean in 1973, a price support for soybean was introduced in 1974, and turned into a payment directed to processors in 1979. A scheme similar to deficiency payment was also introduced for protein crops in 1978. The system enabled to compensate the difference between a guaranteed minimum price and the price of imported soybean meal. This subsidy was targeted to the first processor, including feed companies and improved artificially the competitiveness of EU protein crops against soybean meal. All these supports were very successful and triggered a tremendous increase of the area of protein crops and, to a lesser extent, of soybean. The EU feed industry is very reactive to this type of policy, the most important criteria being that the feed ingredients should be safe, competitive (nutritional value and price) and available in sufficient volumes in order to be incorporated in feed diets.

In 1992 happened a major reform of the CAP. This so-called MacSharry reform translated into a shift from price support to producer support and area-based payments were introduced to compensate the reduction of price support. This move was not favourable to soybean and protein crops and was amplified by the decoupling introduced by the 2003 CAP reform. With fully decoupled support, the payments received by farmers are no longer linked to the crop they grow, in order to encourage farmers to grow the crops providing the largest economic output. The possibility to keep a protein premium of 55.57 €/ha was however maintained and used by most EU countries[3].

This brief description showed the dependency of protein crops from EU policy support. It is up to policy makers to determine whether supporting protein crops is the best option to allocate public resources, taking into account that other options can be considered to improve the EU balance sheet for proteins, as described in the next section.

2 How to improve the EU protein balance sheet?

In this section we will try to analyse different options which could improve the EU protein balance sheet. The nature of these options is twofold. The first category of options addresses the offer, *i.e.* the possibility to supply more proteins to the EU and to produce more proteins in the EU. The second category addresses, the demand, *i.e.* the possibility to reduce the EU demand in terms of proteins. These options are the following:

- Facilitate access to existing sources of vegetable proteins.
- Stimulate local production of vegetable proteins through EU policies.
- Increase the availability of non-vegetable sources of proteins.
- Use available proteins more efficiently, to reduce the needs.

2.1 Facilitating access to the existing sources of vegetable proteins

There are strong incentives in place in the United States to stimulate the production of ethanol. This policy was very successful since the quantity of corn used to produce ethanol in the US rose from 25 million tonnes in 2002/2003 to 124 million tons forecasted in 2013/2014, according to USDA. In 2010/2011, 2011/2012 and 2012/2013, more corn was used

[2] Source: "The environmental role of protein crops in the new common agricultural policy", European Parliament, 2013.

[3] Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, the Netherlands, Portugal, Slovenia, Spain, Sweden, UK.

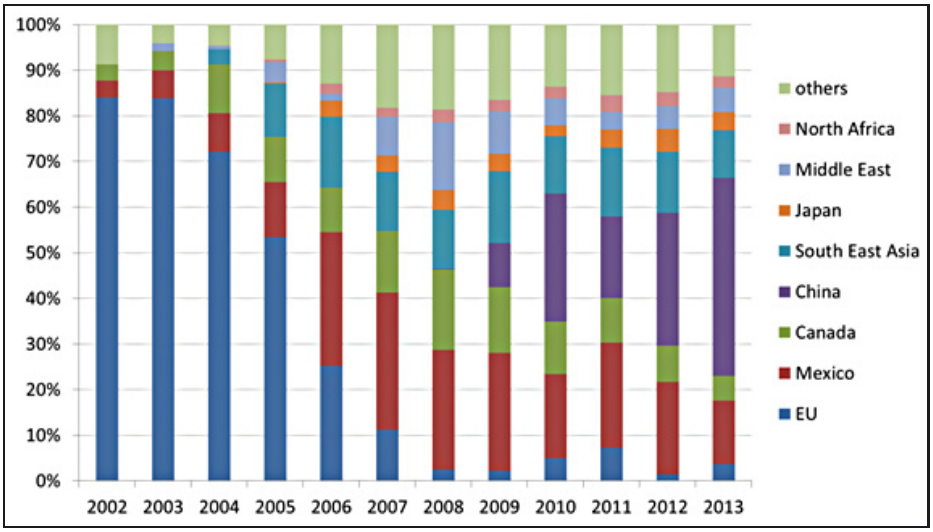

Fig. 5. Evolution of the market share of different countries regarding exports of DDGS from the United States.

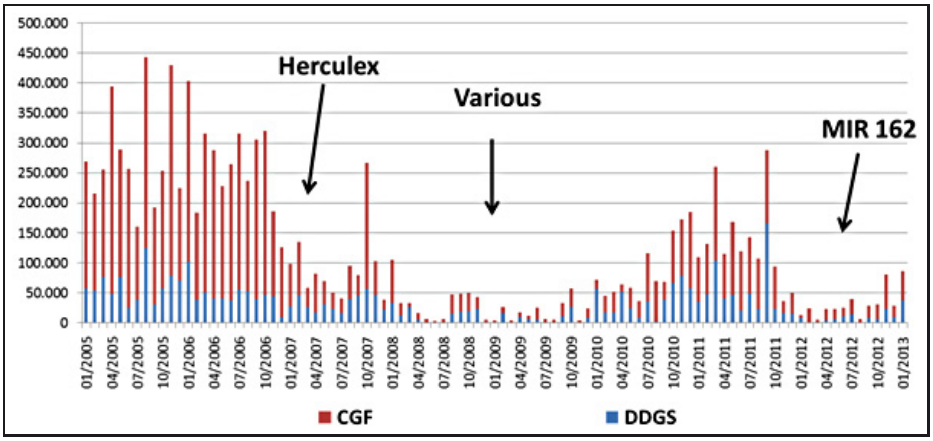

Fig. 6. EU import of corn gluten feed (CGF) and dry distiller's grains (DDGS) from the US in tons (source: GTIS, Toepfer).

for ethanol production than for feed in the US. The production of protein-rich co-products of the ethanol production process such as corn gluten feed (CGF) and dried distillers grains (DDGS) rose accordingly which led to a surplus available for export. The European Union used to be an important customer for US DDGS, but its market share of the US exports decreased drastically during the past ten years, as shown in Figure 5.

The EU GM policy is one of the main factors explaining this evolution. The authorisation procedure for new GM events takes more time in the EU than in agricultural exporting countries using GM technology, such as the United States. This time difference can lead to a situation where a GM event is fully approved by the US authorities and not yet authorised in the EU, even if the event received a positive evaluation by the European Food Safety Agency (EFSA). For such events, the EU used to apply a zero-tolerance policy, meaning that the detection of the event would trigger the impossibility to unload the shipment. Such a policy is not compatible with the agricultural commodities trade. The situation improved in 2011 with the adoption of the so-called technical solution providing a tolerance of 0.1% for this type of GM events. This technical solution is helpful when such new events are produced for seed multiplication but no longer sufficient for commercial use. Figure 6 describes more precisely the impact of the development of new GM events in the United States on the imports in the EU of CGF and DDGS.

The examples above describe the impact of the EU policy regarding the imports of corn by-products, but the same reasoning applies for soybean and soybean meal. While preserving the food safety standards, the acceleration of the EU procedure for the approval of new GM events could facilitate access to existing sources of vegetable proteins. From a strategic perspective, this would therefore reduce the negative aspects of the EU dependency on imports for protein supply.

2.2 Stimulating local production of vegetable proteins through EU policy

2.2.1 What is for proteins in the new CAP?

As seen previously, a dedicated policy is an essential element to stimulate the European production of protein crops. Following two years of discussion and negotiation, the final

acts of the new Common Agricultural Policy for 2014–2020 have been signed in December 2013. We will now look at the potential impact of the new CAP on the European protein crops production. As far as the new CAP is concerned, the so-called greening measures and the voluntary coupled support are the ones with the higher potential effect on protein crops production. These two measures are part of the direct payments regulation. According to the greening measures, farmers will have to dedicate 5% of their farmland to ecological focus areas (EFA). Each member state will have to decide from a list what is eligible as EFA. As supported by FEFAC, nitrogen-fixing crops belong to this list and should be picked up by Member States as an opportunity to stimulate protein production. Another element of the greening measures is the crop diversification rule. Each farmer cultivating more than 10 hectares will have to grow at least two different crops on his farm, and this requirement reaches three different crops for farm exceeding 30 hectares. The impact of this diversification measure on protein crops remains however to be assessed by the EU authorities.

In the framework of the new CAP and in line with the EU 2020 Strategy, the agricultural European Innovation Partnership (EIP) was launched by the European Commission. One of the focus groups of the EIP is dedicated to protein crops. The tasks of the group are to analyse the demand for protein crops in Europe, to assess the potential of relevant crops and forage which are rich in protein, to take into account the value of protein crops in the crop rotation and to make suggestions on how to increase productivity and protein content of protein crops in the EU.

A lot of flexibility has been granted to Member States in the new CAP, including supporting protein crops. In the context of limited availability of land, and taking into account the budgetary constraints, Member States will now have to determine whether supporting protein crops is the most relevant option. Giving priority to livestock in terms of subsidy needs also to be considered as an important element of the overall sustainability of the EU agricultural system. Besides, protein crops have to compete with less land-demanding sources of proteins.

2.2.2 What is the impact of the EU biofuel policy?

Outside the CAP, the EU biofuel policy is probably one of the most effective EU policy regarding protein supply, although it was not necessarily its primary objective.

The Directive 2009/28/EC was adopted on 23 April 2009. This so-called renewable energy directive (RED) introduced mandatory targets for member states to achieve by 2020. These are:

- 20% of overall share of renewable energy,
- 10% of renewable energy in the transport sector.

These regulatory measures created a strong incentive to produce biofuels from agricultural crops, *i.e.* bio-ethanol from cereals and bio-diesel from oilseeds and in particular from rapeseed. The biofuels production from agricultural raw materials also puts on the market protein-rich co-products such as dried distillers grains and oilseed meals, especially rapeseed meal. Thanks to the knowledge in animal nutrition provided by the EU feed industry, these co-products have been turned into a valuable source of protein for animal feeding. The development of the consumption of rapeseed meal in the EU, as shown in Figure 7, is a good example of the positive consequences of the EU biofuel policy on the EU protein supply and on the reduction of the EU protein deficit.

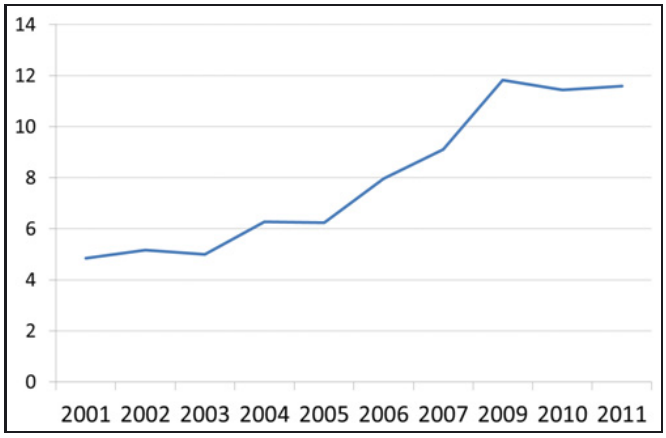

Fig. 7. Evolution of the EU consumption of rapeseed meal (million tonnes, source: FEDIOL).

On the other hand, the agricultural raw materials used as feedstock for biofuels production are also used to produce food and feed, which means the food, feed and fuels outlets compete for the same limited resources such as land and water. The additional competition from biofuels adds some pressure on the agricultural commodities market which is already tight because of the global growing demand for food and feed (this is also valid for some of the 2nd generation biofuels which can be produced from feedstock that can also be used as feed materials). In a difficult economic context, this additional pressure on agricultural markets should be maintained at an acceptable level.

Figure 8 is an attempt to assess the consequences of a capping of the contribution of crop-based biofuels to the RED target to 5%, as proposed by the European Commission. Since this capping corresponds more or less to the current situation, the year 2008 is taken as a reference. Based on the EU split of biofuels, the protein equivalent has been calculated for each protein-rich co-product. The situation in 2008 is compared with the situation in 2020 in a scenario where no action is taken. The estimated total and split for 2020 are based on the national renewable energy action plans which have been submitted by Member States, as mentioned in the impact assessment accompanying the Commission's proposal for the revision of the RED.

Figure 8 shows that around more than 8 million tons of protein equivalent would be lost, with a 5% capping, compared to a no-action scenario. At the same time the quantity wheat and maize used to produce biofuels would jump from 4.95 to 13.43 million tons and from 2.83 to 8.51 million tons respectively. This could not happen without strongly increased competition for access to these raw materials. According to the report published by IFFPRI in 2011 and used by the Commission for its impact assessment, in a no-action scenario imports of rapeseed would increase significantly. Imports of soybean,

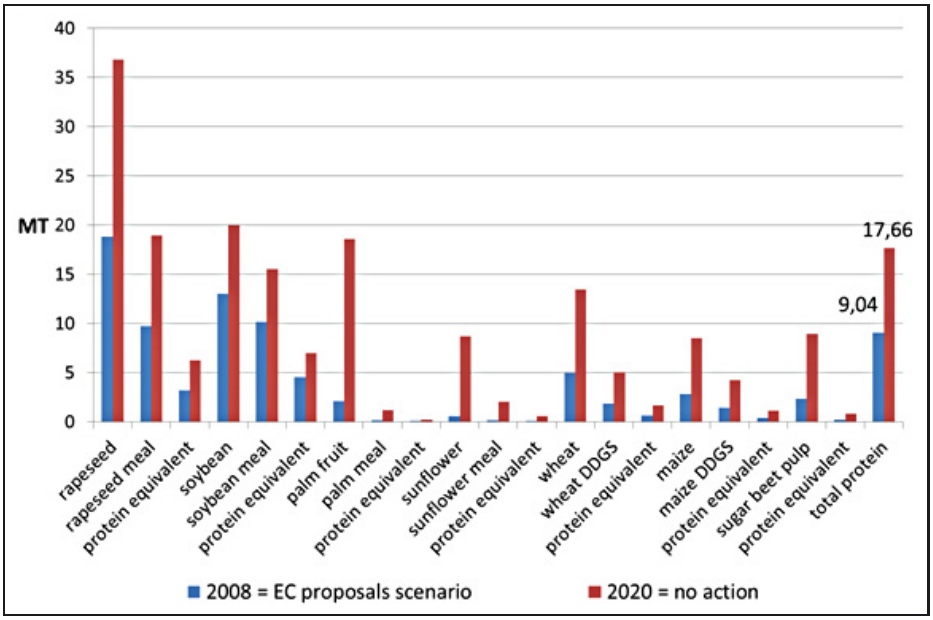

Fig. 8. Impact of 5% capping of contribution of crop-based biofuels versus a no-action scenario in 2020 (source: FEFAC, based on European Commission).

wheat and corn would also increase, but to a lower extent. This means that although more proteins would be available in a no-action scenario, the dependency would not be reduced in the same proportion since more imports would be necessary to meet the biofuels demand.

For the EU feed industry, the objective of the current revision of the RED should be to find the best compromise between the positive and negative side-effects of the EU biofuels policy, both in terms of food security and environmental impacts. In order to mitigate the negative effects of the EU biofuels policy, the capping of the contribution of crop-based biofuels, as initially proposed by the European Commission and voted by the European Parliament is seen by FEFAC as an effective, consistent and robust solution.

2.3 How to increase the availability of non-vegetable sources of proteins?

2.3.1 The processed animal proteins (PAPs)

Following the BSE crisis, a ban on the feeding of mammalian meat and bone meal to cattle, sheep and goats was introduced as of July 1994. In order to manage the risk of presence of prohibited material in ruminant feed through cross contamination, this partial ban was extended to a total EU wide prohibition on the use of any processed animal proteins (PAP), whether from land or marine animals, in feed for any food producing animal on 1 January 2001[4]. The conditions to produce PAP, in particular the treatments and the nature of the animal products eligible for feed use, are strictly defined in the regulation (EC) No. 1069/2009[5], meaning that these products are different from the so-called meat and bone meal (MBM) that were on the market before 2000.

The European Commission made clear that the feed ban would be reviewed in the light of the experience gained with the implementation of the ABP legislation, the effectiveness of controls at Member States level and evolving scientific evidence. It is only in the second so-called TSE Road Map (Transmissible Spongifrom Encephalopathies) issued in 2010 that the European Commission envisaged to relax partially the feed ban, bearing in mind that the prohibition of feeding ruminants with PAPs or feeding non-ruminants with ruminants PAPs will remain in place.

On the basis of this conclusion, the European Commission has tabled a draft proposal in 2011 foreseeing a lifting of the feed ban measure for the feeding of non-ruminant processed animal proteins to pigs, poultry and fish. In other words, the European Commission intends to reauthorize the feeding of: 1. poultry meal to pigs, 2. pig meal to poultry, 3. pig and poultry meals to farmed fish, under strict conditions.

The main control requirements linked to this proposal therefore are the single species dedication of the whole production chain from slaughterhouse to farm level and the "0-tolerance" requirement based on analytical controls using the official microscopic method and the new PCR test whose main role is to identify the species-specific animal proteins in feed.

Due to delays in the validation of robust and accurate methods for pig and poultry, EU authorities decided as a first step to restrict the scope of the re-authorisations to non-ruminant PAPs in fish feed, which entered into application in July 2013[6]. This decision was welcomed by FEFAC to enable reducing the dependency of the aquaculture sector on fish meal thus contributing to the Common Fisheries Policy reform goals of pairing sustainable wild fisheries with the sustainable development of aquaculture. In practice, there is still some resistance in particular from the retail sector to accept the substitution of fish

[4] With some exceptions like the use of fish meal for non-ruminants.

[5] So-called Animal By-Products (ABP) regulation.

[6] Commission Regulation (EU) No. 56/2013 of 16 January 2013.

meal by non-ruminant PAPs. The unfortunate announcement of the lifting of the feed ban for fish during the horse meat scandal even exacerbated negative reactions from the media and also politicians, although there is absolutely no link between the two topics. Given the fact that experience still needs to be gained on the performance of the control methods, it will take some time before non-ruminant PAPs are effectively used in fish feed.

The next step in the TSE Roadmap II is the lifting of the feed ban for pigs, *i.e.* the re-authorization of the feeding of poultry PAP to pigs. This issue is even more sensitive from a political, social and technical point of view, suggesting that no practical step will be achieved before 2016. Unlike fish feed manufacturing plants, the vast majority of feed mills producing pig feed are multispecies. It is therefore essential that the risk management requirements at feed mill level are proportionate and practical so that the use of PAP is possible while ensuring compliance with the intra-species recycling ban. This is not the direction that has been taken so far, meaning that, in practice, more than 90% of the EU feed mills producing pig feed would not benefit from the re-authorisation of poultry proteins in pig feed.

The lifting of the feed ban for poultry is even more complex since poultry covers several species. As an example, the analytical method should enable the detection of turkey PAP in turkey feed while permitting the presence of chicken PAP in turkey feed. This step will obviously require more time and depend on experience gained with fish and pig feed.

All in all it is assumed that out of the 3 million tons of processed animal proteins that could be produced in the EU, a maximum of 1 million tons might be eligible for feeding food producing animals, the rest being for petfood or exports.

2.3.2 Which future for insect proteins?

The possibility to use insects as a source of protein for feed is attracting more and more attention, there are several ongoing research projects across Europe. The use of dried insect proteins falls under the scope of the general feed ban provision[7], which means that they are at this stage authorised in theory for use only in fish feed. The European Commission intends to make it possible to use insect in feed for any non-ruminant species and tabled a regulation proposal in that sense. However, even if such proposal would be adopted, further legislative initiatives would be needed to make the production of insect proteins feasible. The most suitable substrates for a massive production of insect proteins are indeed manure and catering waste, both from an economic and environmental point of view. Manure is not a material fit for direct use in feed whatever the animal species. In addition, insects grown on a farm may not be fed with catering waste. FEFAC recommends assessing from a scientific point of view, and most probably with the assistance of EFSA the risk of feeding insects with such material, in particular as regards potential transmission of contaminants and pathogens to animals and ultimately the transfer to animal products. This is a pre-requisite to enable the development of a solution which makes a lot of sense from a sustainability perspective.

[7] Regulation (EC) No. 999/2001.

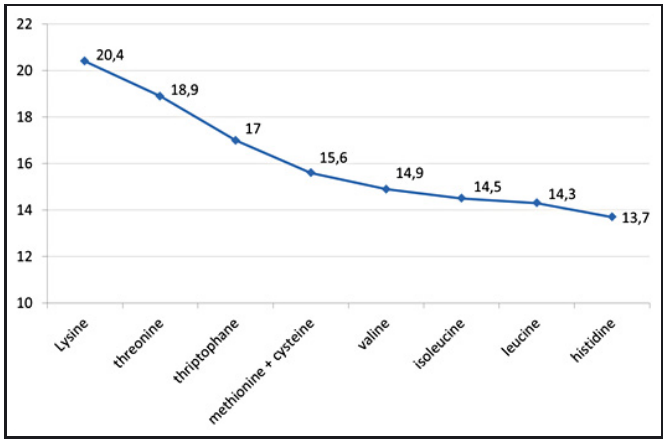

Fig. 9. Evolution of crude protein content of pig feed with the use of amino-acids (source: Ajinomoto).

2.3.3 What is the potential of algae as a source of protein?

The possibility to use algae as a source of protein seems less challenging from a regulatory perspective. The protein content of algae varies according to species between 20 and 70%, expressed in dry matter and the yield potential of algae is very high. Furthermore, algae can use CO_2 as a source of carbon to produce carbohydrates. The main driver for the production of algae seems to be the production of biofuels. In that case, the co-products of such a process could be used as protein sources which is an important factor in terms of sustainability. However, the limiting factor is currently the economic viability of the production of algae.

2.4 Can we use the available proteins more efficiently?

Another option to improve the European balance sheet for proteins is to play on the "demand", in other words to reduce the amount of proteins used in feed diets. The benefits of such an approach are threefold:

- reduced market pressure for the supply of protein-rich feed materials;
- improved resource efficiency, from a more general perspective;
- reduction of Nitrogen emissions in the environment.

The use of synthetic amino-acids in feed diets is a well-known technique to reduce the protein rate of compound feeds. The profitability of such an option is linked to the price ratio of synthetic amino-acids and other sources of vegetable protein, especially soybean meal. The reduction of the crude prude protein rate that can be achieved using amino-acids is significant, as shown in Figure 9.

More innovative options to reduce the amount of proteins used in feed diets have also been identified in the Strategic Research and Innovation Agenda for 2030 developed by EUFETEC[8]. EUFETEC is the European Feed Technology Center, established by several industry organizations across the

[8] www.eufetec.eu.

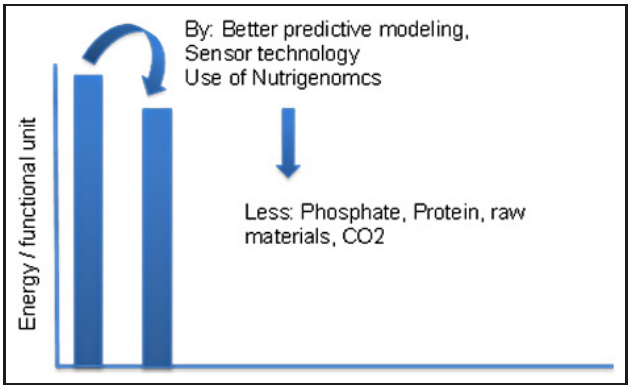

Fig. 10. Impact of innovative technologies.

European Union active in the sector of feed for food producing animals, in collaboration with academia and research institutes. The efficiency of nutrients can also be improved with the help of new control tools, feed evaluation models, dynamic mechanistic animal models and animal response modelling (see Fig. 10.) EUFETEC also considers the need to address current knowledge gaps in the areas of residual feed intake and "precision feeding". Precision feeding refers to the ability to deliver the appropriate nutrients (and no less and no more) at the right moment, to the right animals depending on the animal's physiological characteristics, stage of development and production, while taking into account its genetic potential.

3 Conclusion: call for a pragmatic approach

The question of the European protein supply is complex. From a global perspective, the outlook for livestock products is positive. There is a growing global demand for animal proteins, including fish, and this demand is expected to stay. The challenge for the EU feed and livestock industries is to benefit from this growth and the condition to do so is to remain competitive on the global market. But it is also important for the EU feed and livestock industries to meet this growing global demand in a sustainable way. The reduction of the EU protein deficit may hence be considered as a relevant objective. This deficit should in the first place be assessed with more accuracy. FEFAC would like to call for a more comprehensive European protein balance sheet, including feed ingredients which are not considered today as a source of proteins, *e.g.* cereals. The European feed industry is ready to contribute to such a task.

Before tackling the EU protein deficit, the reduction of the strategic risk should be considered. With a concentrated global protein market, with a declining importance of the EU on this market and with difficulties for the EU to have access to all protein sources available globally linked to the EU GM policy, the situation of the European Union is difficult, from a strategic perspective. In a first step, facilitating access to available protein sources on the global market seems to be a logical move. It will not eliminate the strategic risk, but it will provide a useful leeway to develop local and competitive protein supply.

Since it seems difficult to grow competitive EU protein crops, the question of dedicated public support should be assessed carefully. It is the role of policy makers to find the right balance between support for protein crops and support for the EU livestock sector, which is the driver of the demand for protein crops. Research and innovation will also play a crucial role to improve the competitiveness of EU protein crops, therefore reducing the need for public support.

Increasing the availability of non-land-demanding source of protein such as protein of animal origin, insect proteins and protein from algae is also crucial from a sustainability perspective. The legal aspects and the consumers' sensitivity should however be handled carefully.

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