

6 Exploitation and dissemination

Economic development and scientific and technological prospects – overview of exploitation and dissemination plans

Dissemination of the results of this project is a vital component of its economic exploitation. The dissemination thus far has been less than was originally anticipated, because the proposal underestimated the needs of members of the consortium itself to gain advantage from the knowledge before it became available in the public domain. Thus, the planned session at an international symposium was cancelled for IP reasons; it will still take place, but in 2006 at the earliest. In fact, the proposal underestimated the true value of the results that would come from the project. As a consequence, the key results are in patent form, and the community in general has been well informed about the existence of (but not the results of) the project, but the huge database of results that will be valuable for a large number of researchers and horticulturists will not be released before the period of confidentiality defined by the Consortium Agreement has passed. For the same reason, a proposal for an SSA has not yet been made.

Evaluation by commercial partners

The commercial partners made the following evaluation of the project:

1) General:

The interaction between the industrial and the academic partners was and is of great value and has already produced further co-operations within (REPLACE) and outside (Contract Research) the RUMEN-UP consortium.

2) in vitro screening and databank:

The objective of this project was to investigate the potential use of plant extracts to solve welfare and environmental problems associated with ruminant livestock production. A major in vitro screening of 500 plants and plant extracts by the consortium was very useful with respect to the generation of information on these plants. The scale of the work carried out, would only have been possible with the joint cooperation of all the members of the consortium.

A number of useful developments were achieved. Generally, during product development, researchers actively look for methods to prevent or reduce the use of test animals. Where the use of test animals cannot be avoided, we try to reduce the number of test animals and to refine the experimental design to achieve this. In this sense, the development within this project of a set of *in vitro* test procedures to search for selected target features in materials is to be seen as an important step in such a direction. We expect that the refinement and optimization of the presently developed approaches will lead to a substantial decrease in the number of animals needed to develop new products.

Moreover those approaches could contribute to the development of *in-vitro* models to replace animal testing for licensing/registering purposes; further, studies would profit by a reduced use of animals e.g. to test for efficacy, safety and quality as needed in the production of nutritional, biological, and pharmaceutical products for animals.

The databank of information generated on the 500 plants and plant extracts will serve as a useful source for the potential development of products in the future. In addition, it currently serves as a starting point for the FP 6 project Replace.

3) Selection of candidate materials:

The main selection criteria for materials entering final test stages were exclusively of scientific nature. We suggest that, in other similar projects, additional technical and practical parameters of such materials, such as supply, drying, transport, long term availability and potential to cultivate, be taken into consideration at early stages of the selection procedure.

4) Animal trials:

The somewhat disappointing results of the animal trials emphasize the fact that attempts to correlate *in vitro* data with their *in vivo* counterparts are by far not simple processes. The *in vivo* trials of the present project provided many positive indications; since most of those results were not statistically significant, it was – retrospectively considered - extremely optimistic to hope that such limited *in vivo* trials would provide a definitive proof of the target effect(s). Industrial experience shows that often a number of trials are required before conditions such as dose rate, animal condition, and other factors become sufficiently well known to allow to determine and to demonstrate significant positive effects. For example, known highly successful products such as ionophores and essential oils would very likely share the same kind of success in a similar project as those in the trials carried out in the present project.

5) Knowledge protection:

The protection of the knowledge, raised from the project, via a patent filing is important for potential future implementation of commercial products. The real value of this patent can be evaluated at the time when products will be launched on the market.

6) Possible industrial implementations:

As described above, due to the lack of clearly positive answers of the selected materials from the animal trials, a direct implementation of project results into a commercial product is not foreseeable in the near future; however, the commercial partners do not exclude it for the more distant future. Further trials have to be performed before a decision can be taken to finally develop a product.

Overall conclusions and considerations:Strengths of this project:

The main strength of this project is the quantity of data generated about a diverse collection of plant extracts. This data will be useful in the future as the requirement for natural alternatives to chemical additives in the animal feed industry will become more important.

The opportunity for the range of scientists from different institutes to co-operation in this project has been important. This co-operation has led to various collaborations between the partners and between the industrial partners and the academic institutes. Furthermore, it has led to the subsequent participation in a Framework Programme 6 project (Replace).

Lacks of this project:

There was a lack of foresight as to the risks involved with the collection process for the 500 plants, such as seasonability of some plants and the difficulty obtaining large quantities of the plants. Many of the plants showed positive results during *in vitro* screening however, when the *in vivo* trials were carried out, results were not as positive. Perhaps a preliminary dose response trial should have been incorporated in to the project.

Exploitation by partners

The partners made the following evaluation for their own exploitation of the project:

- The work from the project that Crina will find most useful was that of the first 12 months, and any future product arising from this project will refer to this. Of the 50 Crina oils included in the collection, they now know that the concentrations need to be increased in order to see any effects within this time period.
- UR will continue to work on nettles and lettuce. They will be publishing the *in vitro* work on them. The Rumen-up project will be incorporated into teaching plans for Agriculture students at UR.
- UHOH has put in a proposal for some work with *Knautia*. There is also much left to do on sequencing the bands from the molecular study. UHOH has also

ordered some *Carduus* from ULE to measure anti-methane properties using sheep in respiration chambers, and fermenters may accompany this study. Dr Harinder Makkar of the International Atomic Energy Agency (IAEA), a research associate of UHOH, will use the methane data in his future plans in decreasing greenhouse gas emissions in agriculture

- Alltech have no plans to exploit the results immediately. They will, however, provide a platform at their annual international symposium to disseminate the results
- UL is supervising a PhD thesis based on the theory of Rumen-Up.
- RRI will not be following up any of the proteolytic work directly due to a change in research direction towards human nutrition and gut health. Nevertheless, as regulation of proteolysis in the human intestine is an important criterion for a healthy gut, the results of Rumen-up will be scrutinized for applications for human health.

Exploitation by others

Again because of the confidentiality period built into the Consortium Agreement, there has not been the opportunity for others to review Rumen-up results and to exploit them. Nevertheless, judging by the interest shown already, there will be substantial exploitation of the data when the confidentiality period expires. Interest has been primarily from the horticulture/plant extract sector rather the livestock producer.

A measure of how the project has been received by other countries is that, following visits by Dr Wallace to Australia, China and Wales, where he spoke in general terms about the Rumen-up project, those countries have set up similar projects. The Australian project can be viewed at http://www.animals.uwa.edu.au/pgweb?displaytype=Student_info&id=459. The Chinese project is at the Chinese Academy of Agricultural Sciences in Beijing, headed by Dr Wang. The Welsh project is part of WDA's Knowledge Exploitation Fund: 'Plant-derived antimicrobial activities for use in animal feed: identification by screening, production and optimisation of plant growth conditions using hydroponic technologies.' Its value is £512,000.

Dissemination

Partly because of IP considerations, but mainly because of the nature of the project, the number of publications to date has been small (Table 7.1). Once the period of confidentiality imposed by the Consortium Agreement has passed, it is expected that more papers will be published in peer-reviewed scientific journals covered by Web of Science and with highest-possible impact factors (Table 7.1). There have already been some presentations at international conferences and seminars (Table 7.1); others will follow. The first results were presented at RRI-INRA 2004, the fourth in the series of UK-French gastrointestinal microbiology conferences. A session will be reserved at a US international feed biotechnology symposium in 2006, attended by 800 delegates from throughout the world, to describe and discuss the results. The announcement of this session will reach 10000 customers. A CD and book will be published from this symposium. This dissemination method will enable other researchers to begin to explore the potential value of the plant materials in the collection. The results obtained with each accession will be available on the website, but only when the confidentiality period has expired.

Interest from both electronic and paper media in the Rumen-up project has been keen. Newspaper reports have been described in Periodic Reports. The partners have given more than 30 radio interviews, ranging from 2-minute 'fillers' on commercial radio to 15-minute in-depth discussion on the BBC World Service.

There have been hundreds of e-mails and telephone calls from interested parties.

The results

At the end of the project, the data are in the following forms:

- (a) Preliminary data on 500 materials
- (b) Supplementary data on 20 of these materials
- (c) Pilot trial of 4 materials.

This represents a huge wealth of new information for exploitation, providing information that will increase the competitiveness of EU livestock production and create new market opportunities for the two commercial partners in particular, other biotechnology and feed additive companies, and small rural farming communities.

The agronomic properties of the candidate materials in the study have been assessed by experts for their possible impact on rural development and employment. The crucial next step in implementing such technology transfer will be to undertake many more field trials. The trials carried out within Rumen-up, although successful, could not provide sufficient confidence for industry (either agriculture or biotechnology) to apply the technology immediately. Many more trials are required.