Co-products newsletter
Issue 13

September 2003

THE FIFTH QUARTER

Industrial Applications for Co-products

from STEVE'S desk

Hello everyone,

The 2003/04 financial year is now in full swing and the new co-products program has had a promising start with its successful workshop "Industrial Applications for Co-products". The workshop coincided with the Australian Renderers Association (ARA) international symposium held in July and explored three key opportunities in non-food/feed uses of rendered products – biofuels, industrial applications of rendered products and new processing technologies.

The workshop has strengthened the alliance between the meat processing industry and the ARA as well as establishing opportunities for collaboration with two US-based organisations – the Fats and Proteins Research Foundation (FPRF) and the US Department of Agriculture (USDA).

Dr Lewis Atkinson opened the proceedings with a summary of where the industry has been, and the future direction and opportunities for new uses of co-products and research development. International guests, Dr Rafael Garcia from the USDA Fats, Oils and Animal Co-products (FOAC) Research Unit and Dr Davis Clements, a leading researcher of biofuels and non-food/feed uses of animal products, also gave presentations to the audience, which was made up of processors, renderers, industrial organisations and Australian-based researchers.

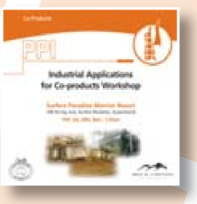
Adding to Australia's research capability, the newly formed Environmental Biotechnology Co-operative Research Centre (EBCRC) will strengthen opportunities for collaboration with our friends in the US, targeting waste streams and low value co-products.

This edition of the Fifth Quarter covers the highlights of the Industrial Applications for Co-products Workshop.

Stephen De Martin
Project Coordinator, Co-Products

Profiling meat and bone meal

Dr Rafael Garcia from the US Department of Agriculture led a breakout session on "Industrial Applications for Rendered Products". Through discussions about meat and bone meal (MBM), the following issues became clear:



Get your copy of "Industrial Applications for Co-products Workshop Proceedings" – available free on CD-ROM.

- MBM is one of the highest volume protein meals, and also the commodity most at risk of losing its market due to perception.
- If the market for MBM disappeared and renderers had to pay to landfill the MBM, they would not be able to operate profitably.
- The technical capacity to burn MBM for fuel value is well developed, but capacity to burn all of the MBM produced is unclear: an over-supply in Europe led to warehousing of large amounts of MBM, and MBM is still shipped to Germany for incineration. Therefore, burning of MBM is not likely to achieve much better than 'break-even'.

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Two major avenues of alternate-use research are available:

1. MBM as a metabolic input for fermentation systems:

- FOAC will be evaluating hydrolysed MBM as an undefined nitrogen source for fermentation media.
- EBCRC may initiate research to adapt wastewater systems to consume MBM. The research centre believes that this could be accomplished in a relatively short time and with longer-term research they believe they could begin to recover valuable products from the fermentations. For example, recent research by this group has developed a system that produces PHA from wastewater.

2. MBM as a functional bulk protein:

- MBM has the potential to be processed into a bioplastic. FOAC's research involves minimal processing of the MBM to produce a crude, opaque plastic, which will probably be most useful for producing thick pieces. MLA is negotiating research into a feasibility study to look at processes to produce finer plastics for applications such as films and packaging.
- FOAC (and possibly Clemson University, South Carolina) will be attempting to harness the bulk functional properties (thickening, adhesiveness, foaming, etc.) of MBM to produce value-added substances.
- Functional utilisation of MBM will likely require its fractionation. MLA has funded this type of research in the past, and its results will be built upon by FOAC.

Potential applications for rendered products

Dr Davis Clements has recently completed a research project titled "Non-food/Feed Uses of Rendering Products: Identification of New Opportunities and Assessment of Major Barriers to their Exploitation". The aim of the project was to identify potential raw material streams for value-added products and to examine the overall material balance for existing rendering operations. This balance includes quantification of all materials input into the plant and identification and quantification of the effluent streams from the plant.

Candidate effluents for non-food product uses

The non-food raw materials identified thus far include hard bone, "fugitive" protein (DAF float, wastewater), keratin materials, fats and greases.

Hard Bone

Bone material is primarily a mixture of calcium phosphate and calcium carbonate, with a number of other minerals present. The calcium occurs as a mixture of hydroxyapatite (HAP) crystals and amorphous calcium phosphate. Hard bones (predominately found in beef leg bones) have a larger fraction of HAP.

Table 1 illustrates the potential application and research needs for adaptation into industrial uses. MLA is currently reviewing these research needs and is seeking partnerships in these areas.

Table 1

Resource material	Application	Research needs for animal proteins
Proteins/ FOG	Polymers/ Plasticisers	• Build on soy-based chemistries • Target specific properties and proteins (eg. collagen, keratin) • Take advantage of multiple functionalities to compensate weak peptide bonding
	Surfactants	• Basic science for mixed amino acid surfactants not developed
Proteins	Adhesives	• Identify animal proteins of least value • Use soy protein adhesive technology as a basis • Develop scalable processes to recover aqueous suspended proteins and MBM proteins • Target high water resistant technologies
FOG	Industrial chemicals	As above
Hard bone	Catalysts	• Develop scalable process for separation of HAP and calcium phosphate • Undertake inventory of typical Ca/P ratios in bones and species.

Biofuels

Tallow – the environmental choice

Biofuels such as ethanol have continued to dominate the headlines in renewable "clean and green" fuels, however, tallow blends in biodiesel applications are arguably superior when economics and environmental benefits are compared.

Petrol, with or without ethanol, might be considered to involve a broader cross section of the motoring public. Although most of the recent government policy measures have been for biofuels, most have been reported exclusively as ethanol/ biofuel measures. Ethanol and biodiesel are different types of renewable fuel, with distinctly different characteristics.

Biodiesel represents the superior biofuel option with a number of benefits, such as:

- a reduction in greenhouse gas emissions by 70 percent;
- it can be used in any blend ratio through existing retail fuel distribution infrastructure; and
- being biodegradable, it is ideal for pristine environments.

Annual and projected production of biodiesel in the USA has had significant growth in the past few years.

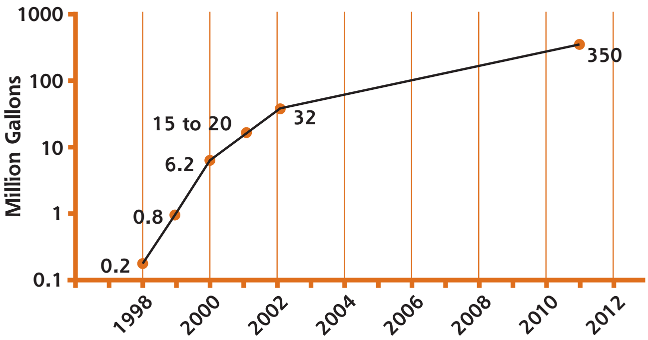
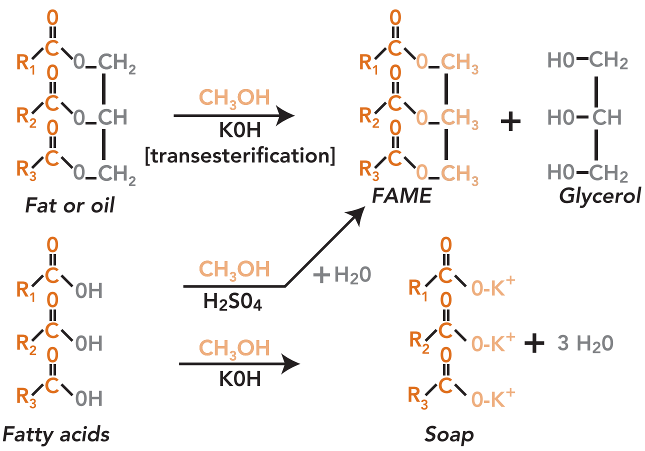


Figure 1

C & E News, May 2002

The following two processes are the common chemical and enzymatic reaction paths to produce biodiesel at industrial scale:

Biodiesel chemical approach



Biodiesel enzymatic approach

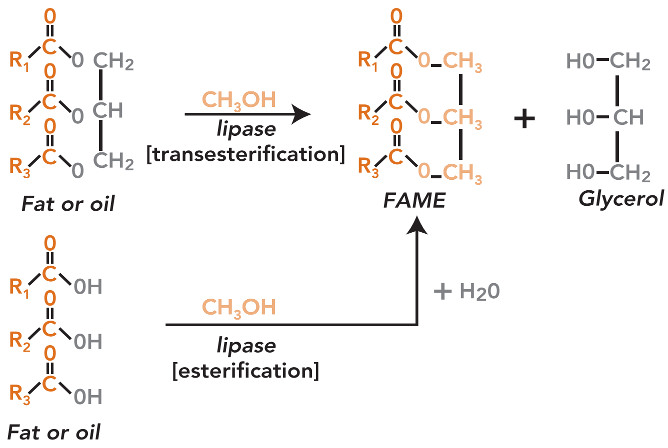


Figure 2

Animal protein meal – oxidation

Considerable concerns have been expressed regarding the oxidation or rancidity of animal protein meals. Concerns have surfaced from the export market as well as specific domestic market segments particularly from the companion animal and poultry end users. Actual sensory or other physical indications of rancidity are not as frequent as the variance in quality assurance testing results that are standard with most purchases.

Peroxide value is a very commonly used test by a number of ingredient purchasers. The peroxide values on protein meals in excess of 5 to 20 meg/kg are associated with deteriorated product even though such indicators of rancidity like flavour, odour, palatability and performance are not evident.

The peroxide number as determined by the AOCS method is actually derived by an analytical procedure directed at fats, oils and greases. It is a measure of its content of reactive oxygen in terms of the amount of iodine liberated by its reaction with potassium iodine and expressed in terms of milliequivalents of iodine per kilogram oil or fat. It is not to be confused with the analytical test method for determination of iodine value used as a measurement of unsaturation in fats and oils.

When the peroxide value measurement is obtained on protein meals the procedure requires the extraction of fat from the product. This procedure in itself depending upon process can produce oxidation. The peroxide value method is sensitive and highly empirical. The correlation of specific values determined on the fat extracted portion of an animal protein has not been compared to the quality, degree of rancidity or expected performance of that specific animal protein. This validation is a necessary void that should be filled to assist in quality assurance program monitoring.

Extract from the FPRF Technical Services Bulletin

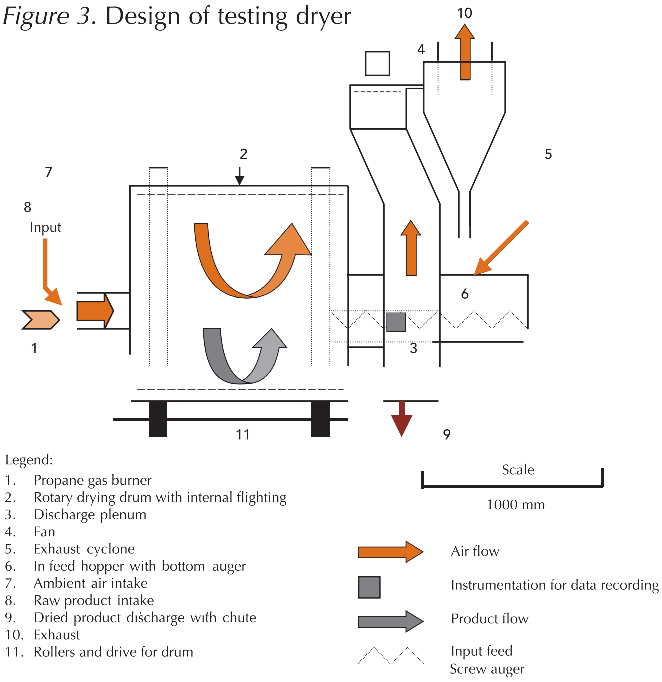
New technologies in rendering

MLA has partnered together with Australian Dehydration Technologies Pty Ltd (ADT) to develop an alkaline dehydration process. The technology has been developed based on the theory that all processes that use heat for sterilisation are dependent on denaturing (altering the shape of) the organic compounds present in the material for biological sterility. In the alkaline dehydration process, biological sterility is achieved by hydrolysing (breaking down to smaller compounds) the organic components of the parent material. The rate and extent of this hydrolysis is governed by the time allowed for the reaction to occur, the temperature of the reaction and the concentration of the alkali. It is this hydrolysis that also leads to the probability that this process will inactivate Transmittable Spongiform Encephalopathy (TSE) in meat and bone meals, of which mad cow disease is one.

The process of alkaline dehydration is similar to conventional low temperature rendering systems, as the process is the same for tallow separation. Once the tallow is removed, the solids fractions and the stickwater, if required, are then treated with the alkali (calcium hydroxide in most cases) and dried at low temperature. The preferred drying equipment is a rotary dryer with a relatively high air throughput. The equipment is illustrated in Figure 3. The results from this laboratory scale project have given excellent guidelines for commercial production parameters of temperature and alkali concentration and further testing will demonstrate the time requirements for TSE inactivation. Even without TSE inactivation, meat and bone meals of high quality can be produced efficiently and effectively.

For further information contact MLA or go to **www.mla.com.au** to order the summary report or final report.

Figure 3. Design of testing dryer



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