Alberta Agricultural Research Institute

Strategic Focus

&

Science Priorities

Alberta Agri-Health & Value-Added Strategic Research Network

January, 2003

prepared by
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Executive Summary

Strategic Research Networks are being organized in 2002/03 under the leadership Alberta Agricultural Research Institute to improve the performance of Alberta's Research & Development and Technology Transfer System in agriculture, food and industrial bioproducts. This report describes the work to December, 2002 to establish the Alberta Agri-Health & Technology Transfer Strategic Research Network.

A group of more than 20 individuals with diverse knowledge of science, engineering, innovation and industry participated in a series of facilitated discussion groups starting in May, 2002 to identify strategic priorities for R&D investment in Agri-Health and Value-Added processing. Key tasks identified for the Agri-Health and Value-Added Strategic Research Network (AH&VA SRN) were to:

- *Facilitate the identification of the strategic focus for research in Alberta into the science, technology, manufacturing and commercialization of wellness foods and dietary supplements, value-enhanced foods and feeds, and value-added ingredients manufactured from Alberta's agricultural resources.*
- *Identify the R&D capacity, infrastructure and human resource needs that will enable an integrated and cohesive response to these strategic focuses to the benefit of Albertans.*
- *Recommend approaches to the Alberta government for investment and collaboration with industry and consumers in strategic focus areas.*
- *Provide leadership to enable collaborative responses to these strategic focuses amongst R&D performers, the industry, and funding organizations.*
- *Enable stakeholders to obtain the required investment from public and private sources to pursue R&D in strategic focus areas.*

Through extensive discussion, the AH&VA SRN segmented the agri-health and value-added processing industry into three main focus areas and thirteen industry sub-sectors, which were then prioritized.

The focus area "Ingredients" was seen to involve industrial extraction, characterization, and formulation of materials into industrial goods (ingredients, additives & fine chemicals) that trade company to company. Firms that would be active in the focus areas "Value-Enhanced Food and Feeds" and "Bioactives" were seen to use ingredients and bioactives as well as other inputs for further tertiary level manufacturing into consumer and branded goods.

The split of industrial goods versus consumer goods was useful to help orient thinking towards strategic focus. This segmentation also helped clarify the necessary linkages between AH&VA to Sustainable Development with respect to new crops, botanicals, yield improvement, quality parameters, etc. and to Bioproducts - for which some of the basic ingredients extracted from crop, animal byproduct and microbial feedstocks could be common processing inputs for both AH&VA and industrial bioproduct manufacturing activities.

The Alberta Agri-Health & Value-Added Strategic Research Network identified three industry sectors for priority R&D investment. Business cases supporting resource requirements and R&D investment portfolio balance over the short, medium and long term were developed for the three sector priorities:

- Value-Enhanced Meat and Meat Products
- Food Ingredients and Fermentation Chemicals
- Health, Wellness and Performance Products.

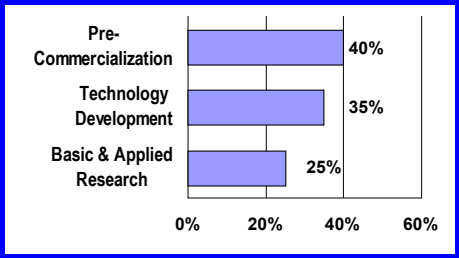
Value-Enhanced Meats and Meat Products

Category	Program Teams	5 Year Investment
1. Infrastructure		$ 6 million
2. Value-Added Meats Product Development	4 FTE	$ 10 million
3. Food Safety & Cold Chain Improvement	4 FTE	$ 10 million
4. Strengthening Industrial R&D Capacity	4 placements	$ 3 million
5. Manufacturing Research Support Team	4 FTE	$ 4 million
6. Market Research, Due Diligence, Intel. Property	Contracted	$ 1 million
TOTAL INVESTMENT		$ 34 million

THE ALBERTA AGRI-HEALTH AND VALUE-ADDED STRATEGIC RESEARCH NETWORK

Value-Enhanced Meats and Meat Products

Portfolio Balance across the R&D Continuum



THE ALBERTA AGRI-HEALTH AND VALUE-ADDED STRATEGIC RESEARCH NETWORK

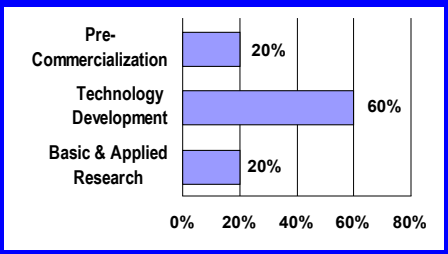
Food Ingredient and Fermentation Products

Category	Program Teams	5 year Investment
1. Infrastructure	Pre-pilot / Clinical	$ 10 million
2. Cereals Science Team	4 FTE	$ 10 million
3. Milling By-Products Science Team	4 FTE	$ 10 million
4. Edible Composites Science Team	4 FTE	$ 10 million
5. Fermentation Science Team	4 FTE	$ 10 million
6. Market Research, Due Diligence, Intel. Property	Contracted	$ 2 million
TOTAL INVESTMENT		$ 52 million

THE ALBERTA AGRI-HEALTH AND VALUE-ADDED STRATEGIC RESEARCH NETWORK

Food Ingredient and Fermentation Products

Portfolio Balance across the R&D Continuum



THE ALBERTA AGRI-HEALTH AND VALUE-ADDED STRATEGIC RESEARCH NETWORK

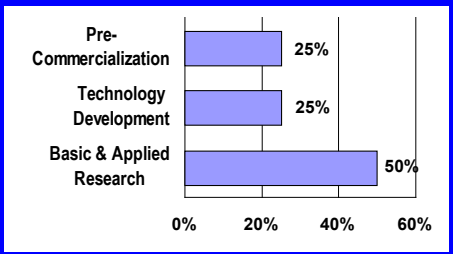
Health, Wellness and Performance Products

Category	Program Teams	5 Year Investment
1. Infrastructure	Pre-pilot / Clinical	$ 10 million
2. Nutraceutical & Functional Foods	4 FTE	$ 10 million
3. Molecular Farming Product & Application	4 FTE	$ 10 million
4. Cancer & Diabetes Disease Prevention / Mgt	4 FTE	$ 10 million
5. Market Research, Due Diligence, Intel. Property	Contracted	$ 2 million
TOTAL INVESTMENT		$ 42 million

THE ALBERTA AGRI-HEALTH AND VALUE-ADDED STRATEGIC RESEARCH NETWORK

Health, Wellness and Performance Products

Portfolio Balance across the R&D Continuum



THE ALBERTA AGRI-HEALTH AND VALUE-ADDED STRATEGIC RESEARCH NETWORK

The Alberta Agri-Health & Value-Added Strategic Research Network

Strategic Focus & Science Priorities

1. Introduction

Alberta Agricultural Research Institute (AARI) is the primary provincial agency promoting, coordinating and funding strategic agricultural research and technology transfer in Alberta.

The need for strategic focus and increased collaboration amongst Alberta research performers, research funders and industry has been identified in several studies of Alberta's agriculture and food research and development and technology transfer (R&D/TT) system.[1,2,3,4] Furthermore, the need for re-positioning and strengthening of Alberta's R&D/TT system was evident given the province's goals to achieve a $10 billion primary production agriculture sector and a $20 billion value added manufacturing sector by 2010.

The circle of engagement of stakeholders in Alberta with interest in agriculture and food R&D/TT is large and complex. In seeking to help Alberta achieve the next critical level of R&D output and innovation and to increase returns to provincial R&D investment, AARI commissioned work in 2001 to design a business model for Strategic Research Networks. The report Business Model for Strategic Research Networks[5] by S. J. Campbell Investments Ltd. identified seven major change levers to transform Alberta's agriculture, food and bioproducts R&D/TT system:

- Leadership – is mission critical to achieving the $20/10 billion goals for value added and primary production.
- Funders align their investment programs with the strategic goals and desired outcomes of ASRA, Innovation and Science and Alberta Agriculture Food and Rural Development.
- AARI lead and bring stakeholders together to establish strategic priorities at Program and Sub-Program levels of new Alberta Strategic Research and Technology Transfer Networks.
- AARI lead and secure stakeholder consensus on Technology Roadmaps and 5-year R&D/TT Plans for specific Programs and Sub-Programs of these networks.
- Funders secure and organize resources, co-venture, and are proactive with R&D/TT performers to prepare awesome proposals, and commit to fund projects contingent only on external scientific review.
- Funding decisions are dynamic through the year, rather than annual.
- Proposals and programs are reviewed externally by independent experts from Alberta, Canada and internationally.

[1] Growth Strategies & Research Investment in Agriculture and Food in Alberta. S. J. Campbell Investments Ltd., George Morris Centre, Discovery Capital Corporation and Hussey & Kilpatrick, for Alberta Agricultural Research Institute. July, 1999.
[2] Research and Development for Alberta's Agriculture and Food Sector: Part 1 Strategic Directions. Alberta Agricultural Research Institute. Sept, 2000 http://www.aari.ab.ca/sec/abo/docs/Strategic_Directions_Aug31.pdf
[3] On-Farm Demonstration Review for Alberta Agricultural Research Institute. Toma & Bouma Management Consultants and Marv Anderson & Associates Ltd, for Alberta Agricultural Research Institute. March, 2001. http://www.aari.ab.ca/sec/new_res/docs/onfarm_demo_report.pdf
[4] Alberta's Agriculture and Food Research & Development & Technology Transfer System, Situation Analysis Report. Serecon Management Consulting Inc., Toma & Bouma Management Consultants & S. J. Campbell Investments Ltd., for Alberta Agricultural Research Institute October, 2001. http://www.aari.ab.ca/sec/new_res/docs/AARIFinal.pdf
[5] Business Model for Strategic Research Networks. S. J. Campbell Investments Ltd., for Alberta Agricultural Research Institute Sept, 2001.

The report recommended the establishment of strategic research networks in specific focus areas to serve as operational units to stimulate change and seek improvements to the R&D/TT system. During the 2002/03 fiscal year, AARI has been fostering the establishment of three strategic research networks:

- Sustainable Production
- Agri-Health & Value-Added
- Bioproducts

AARI intends that these SRNs reflect Alberta's strategic priorities for agriculture, food and industrial bioproducts and succeed in fostering development of critical mass for world-class agriculture, food and bioproducts science and innovation in Alberta. To achieve these objectives, the three SRNs are being organized with the help of diverse groups of stakeholders to guide the initial planning processes and possibly participate in the subsequent implementation of each network.

This report presents the work completed by the Agri-Health & Value-Added Strategic Research Network from May to December, 2002. To date, the emphasis has been to identify strategic focuses and priorities for science and innovation which will enable substantial increases in value-added processing of primary agricultural goods into value-added food, feed, dietary supplements, wellness, performance and medicinal products for humans or livestock. Processed products from agriculture useful for industrial manufacturing, transportation and housing are being considered by the Bioproducts Strategic Research Network.

2. Development Team

Development team members and observers that contributed to this first phase of work of the Agri-Health and Value-Added Strategic Research Network were the following:

Name	Organization
Members	
Dr. Jennifer Aalhus	AAFC Lacombe Research Centre
Mr. Dave Andersen	Lillydale Foods, Edmonton, Alberta
Mr. Ross Bricker	AVAC Ltd., Calgary, Alberta
Mr. John Christensen	Agriculture Food Council, Edmonton, Alberta
Dr. Michael Dugan	AAFC Lacombe Research Centre, Lacombe, Alberta
Mr. Armand Lavoie	Foragen Technologies Ventures Inc., Saskatoon, Saskatchewan
Ms. Penny Mah	Alberta Economic Development, Edmonton, Alberta
Dr. Doug McGinnis	SR&ED, Canada Customs and Revenue Agency, Calgary, Alberta
Dr. Lynn McMullen	AFNS, University of Alberta, Edmonton, Alberta
Mr. Lou Normand	Alberta Economic Development, Edmonton, Alberta
Mr. Ron Pettitt	AAFRD Leduc Food Processing Development Centre
Dr. Terry Rachuk	IRAP NRC, Alberta Food Processors Association, Edmonton, Alberta
Mr. Andrew Raphael	Raphael Management Services, Vancouver, British Columbia
Mr. Robert Rogers	New Crops Network, Edmonton, Alberta
Dr. Feral Temelli	AFNS, University of Alberta, Edmonton, Alberta
Dr. Jackie Shan	CV Technologies, Edmonton, Alberta
Mr. Norm Storch	Farmer, Hanna, Alberta
Mr. Greg Wilkes	Wilkes and Company, Edmonton, Alberta
Observer / Invitee	
Dr. Joe Boothe	SemBioSys Genetics Inc.
Mr. Dave Gilmour	Gilmour Strategies Group
Dr. Linda Malcolmson	Canadian International Grains Institute
Facilitator	
Dr. Stewart Campbell	S. J. Campbell Investments (Facilitator), Cochrane Alberta

3. Network Development

3.1 Bottom Line for Strategic Research Networks

At a mass meeting of the three SRN development teams on May 29th, 2002, Don Macyk, Managing Director of AARI outlined AARI's objectives for the three Strategic Research Networks:

- Develop consensus on the strategic focus for R&D in agri-health & value-added processing.
- Facilitate collaborative strategic priority setting, collaborative funding, and collaborative R&D execution.
- With input from R&D performers, chart the course for R&D investment to contribute to the expansion of the industry.
- Identify and link R&D outcomes with the industry's and society's goals, while considering economic, social and environmental / sustainability perspectives.
- Identify potential R&D spending targets, which are expected to emerge from the consensus developed amongst the SRN team members.

3.2 AH&VA SRN Meetings

The AH&VA SRN Development Team met on 5 occasions between May 29th and September 5th, 2002. Meetings were facilitated by Dr. Stewart Campbell with discussion advancing progressively towards consensus on science priorities and business cases for the identified priorities.

Sector priority statements and business cases were prepared by Dr. Campbell and reviewed by team members. These were shared with the other SRN facilitators, AARI and with Alberta Agriculture Food and Rural Development. The three science priorities identified for agri-health and value-added processing were incorporated into AARI's 2002 Call for Proposals for funding of R&D in 2003/04 and beyond. They are also being incorporated into AAFRD's R&D and Growth plans.

3.3 Tasks for the Agri-Health & Value-Added Strategic Research Network

The AV&VA development team confirmed that the science priorities should align with the AAFRD and Innovation and Science's visions for a $10 billion primary agriculture sector, a $20 billion value-added secondary processing industry, and an expanded life sciences industry in Alberta.

The team identified the mission of the Alberta AV&VA SRN as:

……through science and innovation to enhance the:

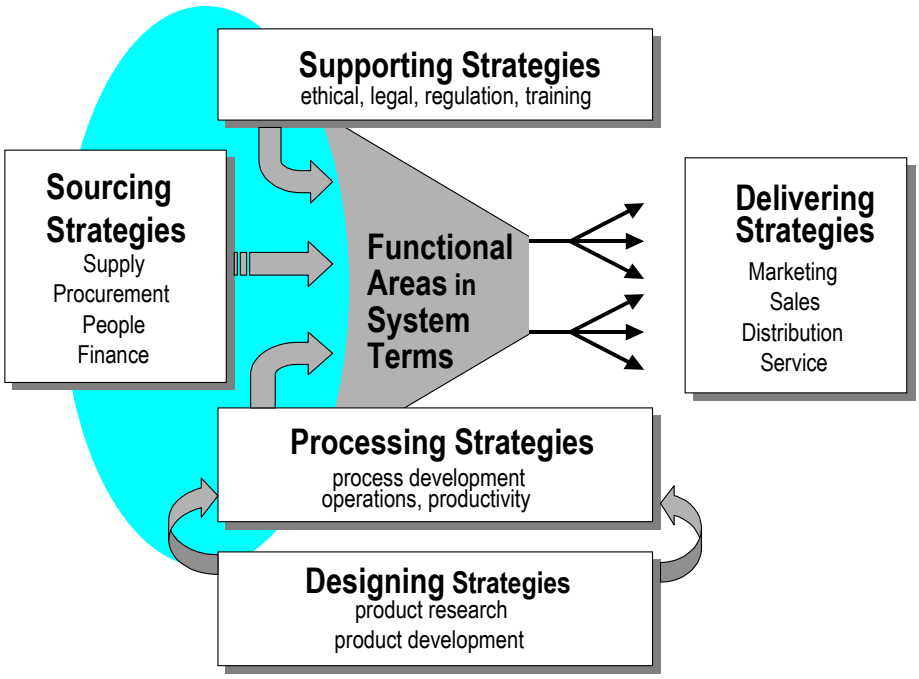
- *Growth and prosperity of Alberta's food and agricultural processing industries.*
- *Availability of safe, high quality, differentiated, value-added product for human use and in livestock production.*
- *Acceptance of new Alberta manufactured food, feed, health, wellness and performance products.*

Key tasks identified by the AH&VA SRN development team were to:

- *Facilitate the identification of the strategic focus for research in Alberta into the science, technology, manufacturing and commercialization of wellness foods and dietary supplements, value-enhanced foods and feeds, and value-added ingredients manufactured from Alberta's agricultural resources.*
- *Identify the R&D capacity, infrastructure and human resource needs that will enable an integrated and cohesive response to these strategic focuses to the benefit of Albertans.*
- *Recommend approaches to the Alberta government for investment and collaboration with industry and consumers in strategic focus areas.*
- *Provide leadership to enable collaborative responses to these strategic focuses amongst R&D performers, the industry, and funding organizations.*
- *Enable stakeholders to obtain the required investment from public and private sources to pursue R&D in strategic focus areas.*

3.4 Criteria to Assess R&D Strategies and Performance

New technology-based industrial development can require scientific discovery, new knowledge generation and knowledge acquisition in many areas of science, engineering, socioeconomics, business, policy and regulation. The figure below illustrates this interaction of many functional areas in system terms.



The AV&VA SRN identified several criteria that might be used to assess R&D strategies and the performance of the Alberta R&D/TT industry:

- World class excellence.
- Internationally recognized.
- Capacity to address short, medium and long-term goals.
- Focused – targeted on strategic spots.
- R&D capacity is industry responsive.
- R&D becomes a key element of the Alberta Advantage.
- R&D integrates social, environmental and economic perspectives.
- R&D exploits Alberta's natural competitive advantages.
- R&D builds and leverages off natural resources and existing capacities.
- R&D is guided by key leading experts.
- Human resources – sufficient in number and expertise to do the job.
- Business and R&D environments are conducive to industry investment.
- Governments become greater risk takers and investors in long term R&D.
- Take risk. With sound management and portfolio balance, the rewards will be there.
- R&D funds induce industry R&D and capital investment in areas of strategic focus.
- Industry participation and investment is realized.
- Alberta becomes the place of choice to conduct agrifood and bioproducts R&D.

The present research generators in Alberta were identified to be:

- Universities – Alberta, Calgary & Lethbridge
- Agriculture and Agri-Food Canada, Lethbridge, Lacombe & Beaverlodge
- Alberta Research Council
- Alberta Agriculture, Food and Rural Development
- Canadian Food Inspection Agency – Animal Disease Research Institute, Lethbridge
- Colleges – Olds College Centre for Innovation
- Industry – which is now responsible for more than 20% and an increasing share of agrifood R&D investment in Alberta.

The team expressed a strong desire to bring researchers and industry together. Special challenges were recognized in venture creation and in retaining successful new ventures.

3.5 Theme Presentations to Identify Focus Areas

Theme presentations were made by several AH&VA team members to increase all member's awareness of specific opportunities and activities pertinent to Alberta's agriculture and food R&D/TT system, particularly in agri-health and value-added processing focus areas. Copies of several theme presentations are included in the appendices.

1. **Moving R&D Funding from Risk to Assurance**. Dr. Doug McGinnis, National Technology Sector Specialist, Scientific Research & Experimental Development, Canada Customs and Revenue Agency. June 14, 2002.

2. **Agri-Health and Value-Added Opportunities for Alberta**. Ron Pettitt, Head, Leduc Food Processing Development Centre, Alberta Agriculture Food and Rural Development. June 14, 2002.

3. **Functional Food for Thought: Strategic Focus in Food Safety and Probiotics**. Dr. Lynn McMullen, Associate Professor, Agriculture Food and Nutrition Science, University of Alberta. June 25, 2002.

4. **Functional Food and Nutraceuticals**. Penny Mah, Alberta Economic Development. June 25, 2002.

5. **Agri-Health and Value-Adding**. Armand Lavoie, Vice President, Foragen Technologies Management Inc. June 25, 2002.

6. **Wheat Bioproducts**. Dr. Stewart Campbell, S. J. Campbell Investments Ltd. Presentation made to the Canadian Wheat Cultivar Development Network, June 4 – 5, 2002. Although the theme presentation was not made to the AH&VA SRN development team, concepts illustrated this presentation were used in the preparation of the business cases for the AH&VA SRN.

7. **Strategic Focus and Science Priorities**. Stewart Campbell, Facilitator. Summary presentation of the three sector priorities identified by the AH&VA SRN to a joint meeting of the three AARI SRN development teams, R&D performers and members of AAFRD preparing an R&D Strategy for agriculture. Sept 26, 2002. The presentation attached contains budgets for each priority revised subsequently based on input received at this meeting.

3.6 Criteria to Identify Focus Areas and Science Priorities.

The team discussed extensively how strategic focus and priorities might be established. An early conclusion was that decisions on priorities should be framed with a balanced view of:

- Industry objectives.
- Economic and social development objectives.
- Consumer objectives.

The AV&VA development team identified several criteria that might be used to help identify focus areas and science priorities. These are listed below in no order of priority.

- R&D outcomes measurable and with a market focus.
- Milestone process implemented - start and exit date for R&D activities.
- Size of the target market a consideration for strategic focus.
- Portfolio balanced across timelines for payoff:
  - Long term (8 – 15 year) initiatives – focus on future technology and promising platform technology,
  - Medium term (4 – 7 year) initiatives – support for emerging areas with commercial potential
  - Short term (1- 3 year) initiatives – content specific focus and for today. Improvement to existing technology, products and markets.
- Recognize differing timelines and requirements for knowledge creation, technology development, product development, venture development, and industry growth.
- Environment is receptive to scientifically based ideas.
- Expansion of money (public and private) available for R&D invested in Alberta
- Technology transfer enhanced and part of the evaluation process.
- Opportunistic – mechanism to handle “flyers”, early success with some quick hits.
- Performance measured at every level of the R&D/TT and Commercialization Continuum.

The researchers on the development team indicated strongly that long term programs and funding are required to provide the stability which is essential to developing strongly focused R&D and scientific human resource capacity. Except for opportunistic pursuits, the researchers felt that short term projects and funding are less valuable and do not provide the stability needed for success, either for the researcher, their sponsoring organizations or for receptor industries.

3.7 Focus Areas

The team discussed extensively the approach to segmenting the agri-health and value-added processing industry into focus areas and sub-sectors.

The focus area "Ingredients" was seen to involve industrial extraction, characterization, and formulation of materials into industrial goods (ingredients, additives & fine chemicals) that trade company to company. By comparison, firms active in the focus areas "Value-Enhanced Food and Feeds" and "Health and Wellness" were seen to use ingredients and bioactives as well as other inputs for further tertiary level manufacturing into consumer and branded goods.

The split of industrial goods versus consumer goods was useful to orient thinking towards strategic focus. This segmentation also helped clarify the necessary linkages between AH&VA to Sustainable Development with respect to new crops, botanicals, yield improvement, quality parameters, etc. and to Bioproducts - for which some of the basic ingredients extracted from crop, animal byproduct and microbial feedstocks could be common processing inputs for both AH&VA and industrial bioproduct manufacturing activities.

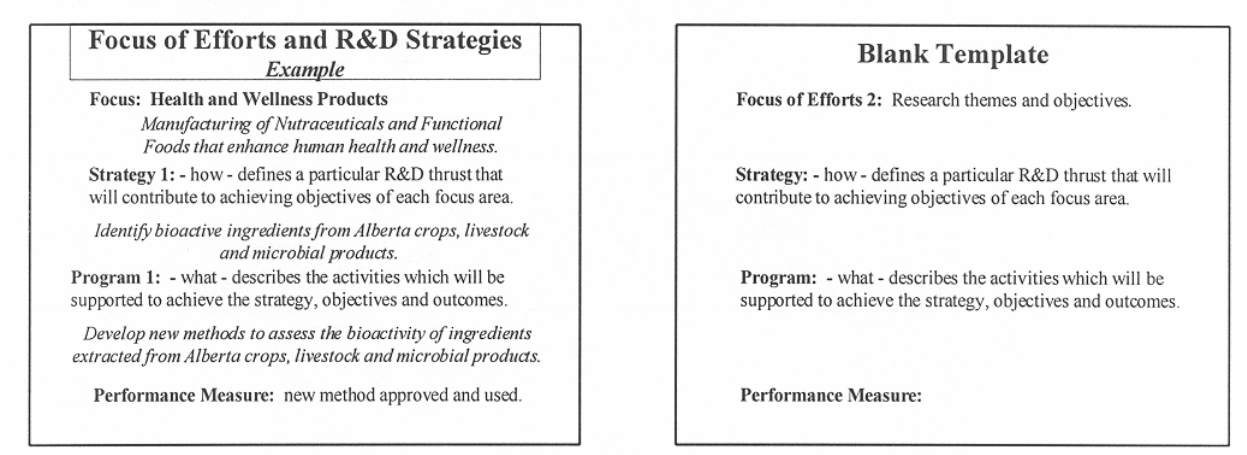
3.8 Enabling Technologies

Discussion was held concerning enabling technologies and the basis on which they might be assessed for relative impacts of R&D investment. Additional discussion will be needed, particularly with research providers, to develop specific strategic science initiatives involving these enabling technologies:

1. Food safety and inspection technologies
2. Biotechnology – microbial genomics and proteomics
3. Analytical methods and information technology
4. Process design and engineering - Separation processes
5. Process design and engineering - Conversion processes including fermentation
6. Process design and engineering - Automation
7. Product Development, Characterization and Assessment - Physical / Chemical / Formulation
8. Product Development Characterization and Assessment - Nutritional and clinical trialing
9. Product delivery systems
10. Competitive and market intelligence

Once focus areas were identified for R&D emphasis, it was felt that R&D performers with experience in specific focus areas and enabling technologies might be contacted to obtain their input as to specific R&D strategies and activities that might be pursued to achieve the goals and outcomes for the focus area. Calls for Proposal were also expected to elicit further input from researchers.

A template was prepared for listing R&D focus, strategies and activities. This template is similar to one used by the USDA ERS for its most recent R&D plan.



3.9 Survey and Ranking of Sector Priorities

Thirteen AH&VA industry sub-sectors in 3 main focus areas were identified for prioritization. A survey instrument to poll individual AH&VA members on sector priorities was developed by Dr. Campbell and discussed extensively by the team. The instrument was tested by four members and improved prior to use. In addition to AH&VA SRN team members, four individuals not directly involved in the SRN development process completed the survey. These individuals included Freda Molenkamp, Research Manager of AARI, Rick Tofani, Chief Executive Officer of Olds College Centre for Innovation, Dr. Peter Sporns, Professor at AFNS, University of Alberta, and Dr. Joe Boothe of SemBioSys Genetics. In total, sixteen responses were obtained in the timeframe requested by the facilitator.

Ingredients – these are products obtained by the extraction, fractionation, derivatization and further modification of components obtained from the primary grains, pulses, oilseeds, botanicals and medicinal plants and related byproducts; and from livestock and meat byproducts. The ingredient products are considered to be industrial goods, meaning they would be sold as intermediate feedstock for other manufacturing and not be sold directly to consumers. The products are value-added based on their unique chemical, physical or sensory properties. Its important to note that separate industry sub-sector was identified for ingredients with bioactive properties and used to manufacture functional food or feed, or health and wellness products. Certain products would be used as feedstock to manufacture fermentation chemicals and industrial bioproducts (the latter being subject matter of the Bioproducts SRN).

Value-Enhanced Food and Feeds – these are manufactured food and feed products including niche products and ethnic foods differentiated on the basis of presentation, packaging, novelty, quality, sensory properties, etc. Products in this focus area are value-added foods and feeds, but are not eligible for health or structure / function claims on product labels or in advertising based on bioactive constituents.

Bioactives – these are bioactive ingredients, nutraceuticals (dietary supplements), functional foods, personal care and cosmeceutical products, and biopharmaceuticals used by humans or in livestock production. Compared with Value-Enhanced Food and Feeds, bioactive products require regulatory approval beyond basic food nutrition and food or feed safety to support health or structure / function claims. These products may also require medical / dietician endorsements and facilitation by professional practitioners for effective product distribution and sales.

Results of the survey are presented in Table 1 on the next page. Criteria used for scoring each industry sub-sector are also given on the page following the results table.

Table 1. Sector Priorities
Agri-Health and Value-Added Strategic Research Network

Average Scores of Responses

From our theme presentations, group discussions and research completed to date, it is evident that many opportunities exist to grow the Alberta industry and improve consumer's choice of products. In Table 1 below, you are asked to assess priorities for R&D investment in specific Agri-Health and Value-Adding sub-sectors according to the 8 criteria identified. Please score each of the 13 sub-sectors considered together for each criteria. Relative scoring system: 5 = High relative priority, 1 = Low relative priority. To differentiate between sub-sectors, it is suggested you score at least one or more sub-sectors as Low and one or more sub-sectors as High. Descriptions of factors to consider for each scoring criteria are listed on the following page.

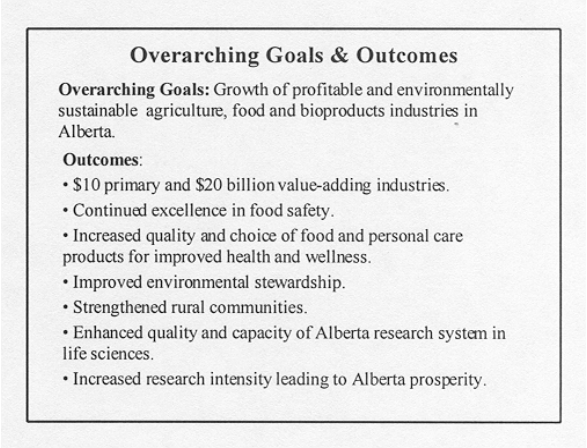
Alberta's Agri-Health and Value-Added Industry Sub-Sectors	1 Market Opportunity for Alberta: sustainable: size, value, profit potential?	2 Impact of R&D Investment on Alberta's Overarching Goals	3 Match of Sub-Sector's Competitive Strengths to Market Factors	4 Capacity of the Sub-sector to Commercialize Results of R&D	5 Unique Contribution of the Science to Alberta's Industrial Competitiveness	6 Strength of Existing Science Capacity in Alberta	7 Synergy of R&D Activity Relative to Alberta AH&VA Clusters	8 Synergy of R&D Activity Relative to Other Alberta Sectors	Score Sum of Criteria 1 - 8	Score Sum of Criteria 1 - 4
Ingredients										
From grains, pulses, oilseeds and related byproducts	4.6	4.2	3.8	3.3	3.9	3.1	3.4	3.7	29.9	15.8
From livestock and meat byproducts	3.6	3.6	3.6	3.4	3.3	3.1	3.4	3.3	27.2	14.2
Value Enhanced Food and Feeds										
Meat and meat products	4.3	4.1	4.0	3.5	3.9	3.7	3.8	3.3	30.5	15.9
Dairy ingredients and products	3.1	2.6	3.3	3.4	3.1	3.1	3.2	2.7	24.3	12.3
Beverages	2.6	2.4	2.6	3.1	2.3	2.3	2.3	2.2	19.7	10.7
Prepared Foods	3.4	3.5	3.4	3.2	3.3	2.8	2.9	2.9	25.2	13.4
Value enhanced livestock feeds	3.4	3.3	3.3	3.4	3.1	2.8	2.9	2.6	24.8	13.3
Beverages	2.8	2.3	2.1	2.6	2.4	1.8	2.1	1.7	17.8	9.8
Bioactive Products										
Bioactive ingredients	3.5	3.1	2.9	3.1	3.3	2.8	2.9	3.2	24.9	12.6
Nutraceuticals	3.3	3.8	2.8	2.4	3.8	2.9	3.2	3.1	25.3	12.3
Functional Foods	3.6	4.1	3.3	2.8	3.8	3.1	3.2	3.3	27.2	13.9
Personal Care & Cosmeceuticals	3.1	3.1	2.6	3.0	3.0	2.1	2.4	2.6	21.9	11.8
Biopharmaceutical	3.5	3.5	2.9	2.6	3.6	2.8	2.9	3.2	25.0	12.5

Table 1. Sector Priorities, continued

Description of Scoring Criteria

1 Market Opportunity for Alberta: Markets exist. Large market. High potental for profit. Markets likely to be sustainable?

2 Impact of successful commercialization of the R&D results in this sub-sector on the goals and desired outcomes for the Alberta industry. For example, highest impact, therefore highest score, might be - high profitable $ value-added ~~*times*~~ high volume.



3 The industry's competitive strengths match with market factors that might be very important in the future. For example - regulations, market access, value chains, competitiveness, labor, utilities, foreign exchange, transportation, logistics, etc.

4 Receptor capacity: Ability of the industry in this sub-sector to commercialize results of the R&D.

5 Because of the unique contribution of the science to Alberta's industrial competitiveness, Alberta should build and/or expand scientific capacity and leadership in this sub-sector.

6 Relative strength of Alberta's science capacity in this sub-sector compared to competitors in the sub-sector.

7 Level of synergy relative to Alberta's Agri-Health and Value-Added clusters. A cluster has a number of aspects: research and development supports, established companies, emerging companies, service providers, facilitation - all located in proximity to each other. This clustering helps create critical mass for successful industrial development.

8 Level of synergy relative to other Alberta industrial sectors and sub-sectors. Potential to apply and leverage results from R&D investment in agri-health and/or value-added in other industry sectors in Alberta outside of agriculture.

4. Sector Priorities

4.1 Priority Statements

Based on the survey results and relative rankings of the 13 industry sub-sectors, three sector priorities were identified for strategic focus and development of business cases. These were:

- Value-Enhanced Meat and Meat Products
- Food Ingredients and Fermentation Chemicals
- Health, Wellness and Performance Products.

Brief sector priority statements were prepared and distributed amongst the three SRN facilitators as well as AARI and AAFRD management.

Copies of the three priority statements for the AH&VA SRN follow on the next three pages.

4.2 Business Cases

Based on positive feedback on these priorities, business cases prepared by Dr. Campbell and reviewed by members of the development team. Business cases are attached with resource requirements and illustrative targets updated based on feedback from a joint SRN meeting held Sept 26th with R&D performers, Alberta Funding Consortium and AARI and AAFRD representatives.

Resource summaries and the suggested portfolio balance across the R&D/TT and Commercialization Continuum are presented for each sector priority on the fourth page following.

Value-Enhanced Meats and Meat Products

Sector Priority

Value-enhanced meats and meat products represent a $2.0 – $4.0 billion value-added growth opportunity for Alberta, in a meat manufacturing sector that in 2001achieved $3.6 billion shipments from animal slaughtering (not including poultry) and $1.6 billion shipments in processed meat and poultry products.

Priority investments in meats R&D and Commercialization can build on existing Alberta world-class R&D strengths in livestock production, meat slaughtering, meat quality and food safety. Analysis (AAFRD 2001) shows that Alberta's primary beef production sector is globally competitive. However, increasing the value, volume and share of Alberta beef products in domestic and export markets is seen to be key to industry viability. Value enhanced products will enable Alberta processors to reach discriminating domestic and international customers with a variety of new, appealing, safe and nutritious meat products.

Vision and Outcome

A profitable and dynamic meats sector shipping $3.0 to 5.0 billion per year of branded, value-enhanced meats and meat products to targeted domestic and international markets.

Research Theme Priorities

The cornerstones of building new markets for value-enhanced meats are branding and consumer's acceptance of new products featuring:

- Health and food safety.
- Quality and nutrition.
- Product innovation.

Focused research and technology development is required that addresses these cornerstones and enables Alberta's meat processing firms to:

- Meet targeted demand in retail and food service with products having attributes important to diverse consumers i.e. ethnic, demographic, gender, organic, natural, etc.
- Market products that address changing consumer demands, i.e shift from commodity to meal replacement, chilled to pre-cooked, etc.
- Exploit new processing technologies for production of case-ready, pre-cooked and convenience premium meats, meat products and meal replacements.
- Achieve better utilization and margin contribution from value cuts.
- Implement science-based health and safety QA and QC inspection procedures.

New meat science, engineering and informatics knowledge is important, not only to manufacture premium meat products, but also to support dynamic marketing in support of branding, traceability, consumer education and awareness of Alberta premium meat products, particularly as the industry responds to food safety concerns, country of origin labeling and changing trade environments.

Measures

Short Term

- New scientific collaborations with domestic and foreign meat processing companies.
- New high-value case ready and processed meat products developed and market-ready.

Medium Term

- Health and safety issues addressed.
- New diagnostics and analytical tools.
- New processing investments committed.

Long Term

- Much improved understanding of the ecology and evolution of pathogenic microorganisms.
- Increased industrial R&D activity extending the reach of Alberta value-enhanced meat products in global markets.

Benefit / Impact for Alberta

- Recognition of Alberta as an international leader in meat processing and meat science.
- A vibrant growing meat processing industry, reflected by rapid commercialization of differentiated products, consumer confidence, new investment, and expansion of facilities.

Required Science Capacity

- New domestic and international science and engineering collaborations with industry.
- New product development, engineering and informatics expertise focused on value-enhanced packaged meats and meat products.

Implications for R&D System Business Plan

- Networked facilities (Canadian International Meats Institute) in Alberta to provide formal and non-formal training in meat science and food safety to domestic and international customers, conduct competitive intelligence, and facilitate the development and introduction of new value enhanced meat products.

Food Ingredients and Fermentation Products from Crops

Sector Priority

Alberta's advantages are the foundation to establish a new $2 to 3 billion world-scale crop extraction, conversion and fermentation industrial sector. The global food ingredient and fermentation markets are large and growing with innovation leading to new and enhanced consumer and industrial products. Crop ingredients and fermentation products make only a small contribution to Canada's $31 billion (1997) manufacturing shipments of food ingredients, chemical and biochemical products. The wheat, coarse grains, oilseeds and pulses now exported are excellent feedstocks for the extraction and conversion of starch, protein, oil, fibre and cellulose into valuable ingredients with specific functionalities and uses.

Vison and Outcome

A new $ 2 to 3 billion crop extraction, conversion and fermentation sector established that creates unparalleled new demand for Alberta crops.

Research Theme Priorities

The foundations for globally competitive ingredients and fermentation products industries are:

- Supply and quality of crops for processing.
- Competitive inputs (energy and labor).
- Supportive industrial environment.
- Processing and product innovation.
- Distribution and customer service.

Focused research is required to create, acquire and adapt technology and product platforms to:

- Exploit Alberta's advantages in certain cereals, oilseeds, pulses, forages and botanicals.
- Enable the manufacturing of ingredients and fermentation products from Alberta crops.
- Meet targeted demand for ingredients used in food, feed, personal care, cosmetic, pharmaceutical and industrial goods.
- Market differentiated products based on intrinsic properties (physical, chemical, biochemical, sensory, nutritional and bioactivity).

Alberta's major crops are distinctly different to the US's major crops. Best practices in corn and soybean ingredient technologies are not always applicable to Alberta's crops. It is essential that scientists and engineers adapt or create new processes and differentiated products specifically for crops where Alberta has competitive advantage.

Measures

Short Term

- New science and engineering collaborations with global food ingredient and fermentation product manufacturers.
- Emerging science identified and R&D aligned with expected industry demand for specific food ingredients and fermentation products.

Medium Term

- Alberta R&D performers partnered with foreign institutions in order to collaborate, benchmark, attract technology, and scout human resources.
- Major food ingredient and fermentation processors attracted to invest in Alberta.

Long Term

- Diversification on a grand scale of Alberta's crop production and processing bases.
- Global leadership in food ingredient areas that leverages Alberta's comparative advantages.
- Many company creating platform technologies patented and ready for commercialization.

Benefit / Impact for Alberta

- Recognition of Alberta as a leader in specific areas of crops and ingredients manufacturing.
- Bridges to other industrial sectors, building on R&D and industrial capacity created in food ingredients and fermentation products.
- Launch pad for entry into branded consumer food, feed and industrial products.

Required Science Capacity

- Science and engineering expertise focused on product and process developments in targeted areas and serving emerging value chains in food ingredients and fermentation products.

Implications for R&D System Business Plan

- A multidisciplinary research, engineering and technology centre in Alberta to help create, catalyze and develop Alberta's food ingredients and fermentation products industries.
- Alignment of Alberta and federal science programming in crop science, food science, biochemistry, biotechnology, material science and engineering so as to enable the development and establishment of ingredient and fermentation industries in Alberta.
- Science, new venture, new industry and infrastructure foundations established with required resources.

Health, Wellness and Performance Products

Sector Priority

Health, Wellness and Performance (HWP) products using bioactives obtained from agriculture represent a $0.5 to $2.0 billion opportunity for Alberta. Regardless as to HWP markets are described, exceptional growth is projected in many categories. Aging demographics and consumers taking responsibility for their health, wellness and performance are fueling nutraceutical, functional food, personal care, alternative medicine and pharmaceutical markets. Global sales of plant-derived medicines, both prescribed and non-prescribed, were projected at $US30.7 billion for 2002 (RIRDC 2002). World demand for nutraceutical chemicals by 2004 is projected at $US11.2 billion, supplying a $US162 billion nutritional products industry (Freedonia 2000). US functional foods sales were US$18.5 billion in 2001 (3.7% of the total US food market) and projected to reach $US31 billion by 2010 (Nutrition Business Journal 2002). New products are emerging containing dietary fibres, polyunsaturated fatty acids, oligosaccharides, phospholipids, phytosterols, phytoestrogens, antioxidants, peptides and probiotic bacteria. The possibilities for proprietary blockbuster products is attracting global food, pharmaceutical, chemical and venture capital firms. Several initiatives in Alberta are probing bioactives and novel product delivery vehicles, but these are in their infancy, needing focus, scientific and institutional collaborations, infrastructure and critical mass.

Vison and Outcome

A new $0.5 to $2 billion bioactives industry supplying a range of innovative and branded health, wellness and performance enhancing products.

Research Theme Priorities

The basis for entry into nutraceutical, functional food, personal care and biopharmaceutical industries are the "right" bioactives with demonstrated:

- Chemical, physical and molecular properties.
- Nutritional, physiological and clinical functionality.
- Product format for specific clinical indications.
- Intellectual property and branding potential.

Focused research is required to:

- Identify and characterize bioactive constituents in crops and botanicals where Alberta has or can develop comparative advantage.
- Demonstrate safety, bioactivity, bioavailability, pharmacological properties and efficacy in human diet and health.
- Develop cost-effective separation, processing and conversion technologies while maintaining and improving bioactivity and efficacy.
- Develop product formats appropriate for the target global consumer market, clinical indication and channel needs.
- Market products with science-based claims.

Many of Alberta's major and specialty crops naturally contain bioactive constituents with potentially useful biological functionality. Through genetic engineering and molecular farming, agricultural production of novel bioactive entities in adapted crops and domestic livestock is also envisioned.

Measures

Short Term

- Lead bioactives from Alberta's agricultural resources identified.
- R&D aligned with consumer demand for disease prevention, health promoting and performance enhancing products.

Medium Term

- Efficacy of lead candidate bioactives in specific consumer product formats established.
- Alberta food processors exploiting functional foods for brand differentiation and growth.

Long Term

- Major functional food, cosmetic and pharmaceutical firms attracted to invest in Alberta.
- Global leadership in molecular farming of bioactives that leverages Alberta's comparative advantages in agriculture and science.

Benefit / Impact for Alberta

- Agriculture contributing to health and wellness.
- Recognition of Alberta as a leader in specific areas of molecular farming for HWP products.

Required Science Capacity

- Scientific expertise experienced in building product / company creating technologies.

Implications for R&D System Business Plan

- Networked facilities that cross disciplines and institutions engaging agriculture, food science, chemistry, biochemistry, molecular biology, pharmacology, epidemiology and engineering.
- Resources to build a new bioscience-based industry providing high social benefits and long-term, sustainable economic rewards.

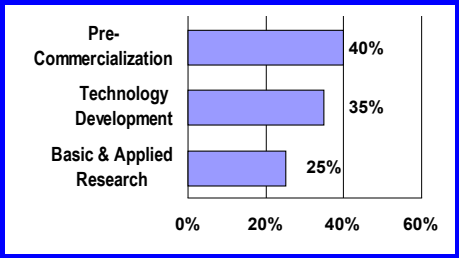
Value-Enhanced Meats and Meat Products

Category	Program Teams	5 Year Investment
1. Infrastructure		$ 6 million
2. Value-Added Meats Product Development	4 FTE	$ 10 million
3. Food Safety & Cold Chain Improvement	4 FTE	$ 10 million
4. Strengthening Industrial R&D Capacity	4 placements	$ 3 million
5. Manufacturing Research Support Team	4 FTE	$ 4 million
6. Market Research, Due Diligence, Intel. Property	Contracted	$ 1 million
TOTAL INVESTMENT		$ 34 million

THE ALBERTA AGRI-HEALTH AND VALUE-ADDED STRATEGIC RESEARCH NETWORK

Value-Enhanced Meats and Meat Products

Portfolio Balance across the R&D Continuum



THE ALBERTA AGRI-HEALTH AND VALUE-ADDED STRATEGIC RESEARCH NETWORK

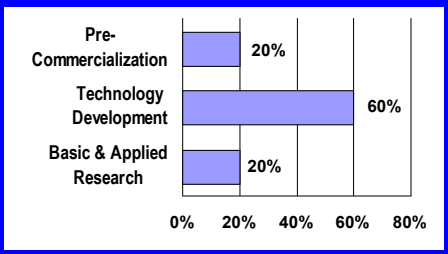
Food Ingredient and Fermentation Products

Category	Program Teams	5 year Investment
1. Infrastructure	Pre-pilot / Clinical	$ 10 million
2. Cereals Science Team	4 FTE	$ 10 million
3. Milling By-Products Science Team	4 FTE	$ 10 million
4. Edible Composites Science Team	4 FTE	$ 10 million
5. Fermentation Science Team	4 FTE	$ 10 million
6. Market Research, Due Diligence, Intel. Property	Contracted	$ 2 million
TOTAL INVESTMENT		$ 52 million

THE ALBERTA AGRI-HEALTH AND VALUE-ADDED STRATEGIC RESEARCH NETWORK

Food Ingredient and Fermentation Products

Portfolio Balance across the R&D Continuum



THE ALBERTA AGRI-HEALTH AND VALUE-ADDED STRATEGIC RESEARCH NETWORK

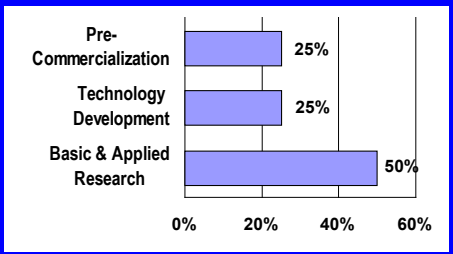
Health, Wellness and Performance Products

Category	Program Teams	5 Year Investment
1. Infrastructure	Pre-pilot / Clinical	$ 10 million
2. Nutraceutical & Functional Foods	4 FTE	$ 10 million
3. Molecular Farming Product & Application	4 FTE	$ 10 million
4. Cancer & Diabetes Disease Prevention / Mgt	4 FTE	$ 10 million
5. Market Research, Due Diligence, Intel. Property	Contracted	$ 2 million
TOTAL INVESTMENT		$ 42 million

THE ALBERTA AGRI-HEALTH AND VALUE-ADDED STRATEGIC RESEARCH NETWORK

Health, Wellness and Performance Products

Portfolio Balance across the R&D Continuum



THE ALBERTA AGRI-HEALTH AND VALUE-ADDED STRATEGIC RESEARCH NETWORK

4.3 AARI Science Priorities

The three Strategic Research Networks completed their work to identify sector priorities in the fall of 2002. The 9 focus areas identified by the Sustainable Development, Agri-Health & Value-Added, and Bioproducts have strong interacting linkages, dependencies and synergies.

Agri-Health and Value-Added Research

1) Food Ingredient and Fermentation Products
2) Value-Enhanced Meats and Meat Products
3) Health, Wellness, and Performance Products

Bio-Products Research

1) Bio-Materials Products
2) Bio-Energy Technologies and Products
3) Bio-Industrial Chemical Technologies and Products

Sustainable Production - Research Supporting Profitable Sustainable Production

1) Sustainable Production Systems for Specific Traits in Crops and Livestock
2) Nutrient Efficient Systems in Integrated Crop and Livestock Production
3) Microbial Management Systems

Research and Development Infrastructure

1) Build on Current Infrastructure Resources
2) Fill Infrastructure Gaps
3) Infrastructure for All Priority Areas

Due Diligence, Market Research, Regulatory

This first phase of the development of the 3 Strategic Research Networks were facilitated by Dr. Stewart Campbell (Agri-Health & Value-Added), Darrell Toma (Bio-Products), and Dr. Scott Wright (Sustainable Production).

AARI is now establishing champions for the networks to ensure an ongoing renewal and expsnions of Alberta's R&D/TT system for agriculture, food and bioproducts. Program Teams in the strategic areas are emerging through a number of mechanisms. Proposals for work in these three network areas are under consideration by the Alberta Funding Consortium as part of the 2003/04 funding round launched in August, 2002. In addition, AARI may announce targeted call for proposals, and is currently supporting the development of program proposals in targeted areas of focus.