Moving R&D Funding *from Risk to Assurance*

Discussion
Agri-Food and Value Adding Network
Development Team meeting of June 14, 2002

Prepared by Doug McGinnis

The Value of R&D

- Builds useful knowledge base
- Develops technical skills
- Extends education
- Improves products/processes/systems
- Creates new markets/employment/etc.
- Improves economic competitiveness
- Supports future decision-making
- Expands synergistic potential of S/T

Sorting The Benefits….

- Short term vs. Long term
- Incremental vs. Quantum
- Tangible vs. Intangible
- Quantitative vs. Qualitative
- Serendipitous vs. Planned
- Inspiration vs. Perspiration

"*Time well wasted?*"

R&D Focus and Priorities *(typical)*

- Topics of strategic importance
- Topics of wide application in a field
- Consistent with societal values and goals
- Strong indication of high ROI
- Risk correlates with R&D value

Follow-through sometimes lacking …development chain

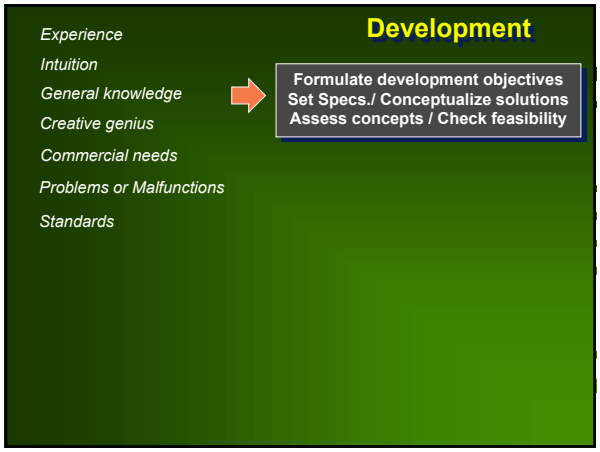
R&D Funding fails to deliver value because…..???

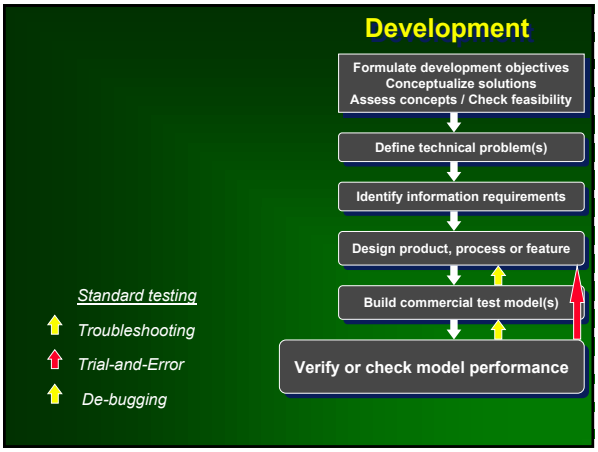
- Funding agency sets inappropriate goals
- Planning was insufficient to meet objectives
- Unable to respond to the unexpected
- Wrong barriers / challenges were addressed
- Funding and/or confidence was eroded
- The competition was too fast & too smart
- Personnel or expertise was lacking
- Technical challenges were insurmountable
- Development-marketing "chain" is broken

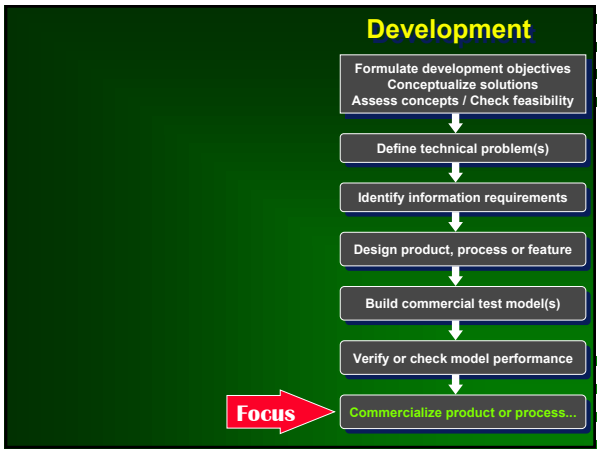
Causes of success in new products *(Robert G. Cooper)*

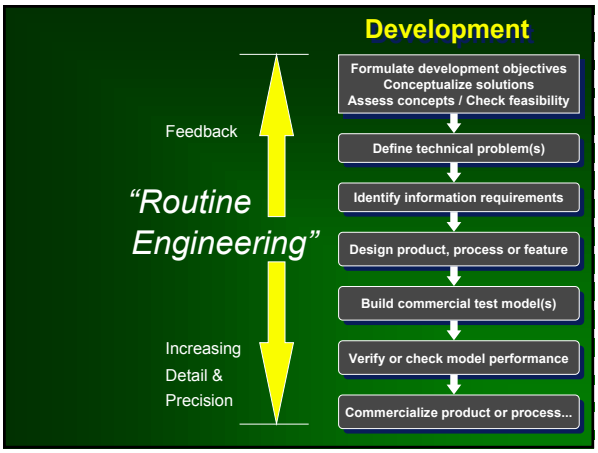
- Differentiated, superior products
- Sharp, early product definition
- Solid, up-front homework
- Marketing actions executed well
- Technology actions executed well
- True cross-functional teams

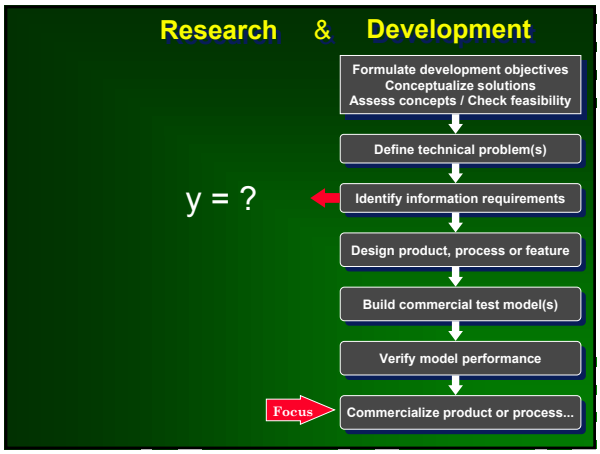
(source: Robert G. Cooper, 1998; reference: Preston Smith, 1999)

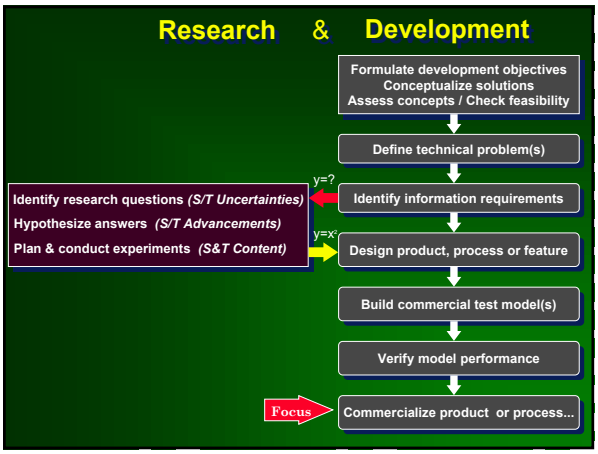

Development
Experience
Intuition
General knowledge
Creative genius
Commercial needs
Problems or Malfunctions
Standards
Formulate development objectives
Set Specs./ Conceptualize solutions
Assess concepts / Check feasibility

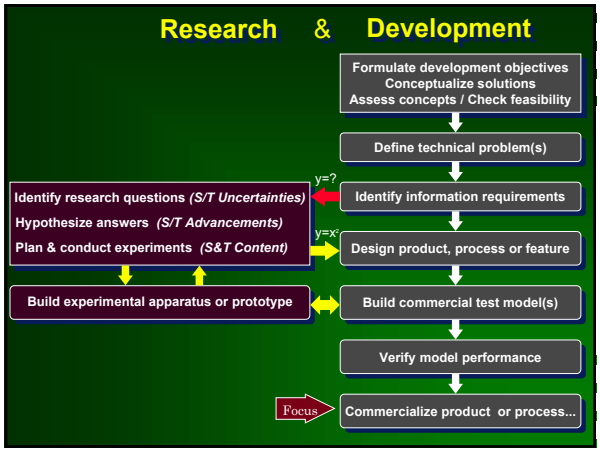

Development
Formulate development objectives
Conceptualize solutions
Assess concepts / Check feasibility
Define technical problem(s)
Identify information requirements
Design product, process or feature
Build commercial test model(s)
Verify or check model performance
Standard testing
Troubleshooting
Trial-and-Error
De-bugging


Development
Formulate development objectives
Conceptualize solutions
Assess concepts / Check feasibility
Define technical problem(s)
Identify information requirements
Design product, process or feature
Build commercial test model(s)
Verify or check model performance
Focus
Commercialize product or process...


Development
Feedback
"Routine Engineering"
Increasing Detail & Precision
Formulate development objectives
Conceptualize solutions
Assess concepts / Check feasibility
Define technical problem(s)
Identify information requirements
Design product, process or feature
Build commercial test model(s)
Verify or check model performance
Commercialize product or process...


Research & Development
y = ?
Formulate development objectives
Conceptualize solutions
Assess concepts / Check feasibility
Define technical problem(s)
Identify information requirements
Design product, process or feature
Build commercial test model(s)
Verify model performance
Focus
Commercialize product or process...

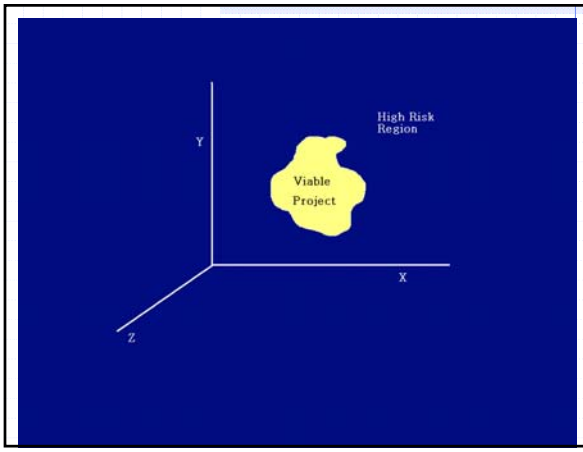

Research & Development
Identify research questions (S/T Uncertainties)
Hypothesize answers (S/T Advancements)
Plan & conduct experiments (S&T Content)
y=?
y=x²
Formulate development objectives
Conceptualize solutions
Assess concepts / Check feasibility
Define technical problem(s)
Identify information requirements
Design product, process or feature
Build commercial test model(s)
Verify model performance
Focus
Commercialize product or process...



Project Failure - *Factors*

- Objectives
- Planning
- Resources
- Time
- Environment

Failure may be due to avoidable Risks



Objectives

- Consensus based
- Realistic
- Worthwhile
- Prioritized
- Linked and coherent
- Verifiable

Project Plans

- Consensus based
- Integrated with related plans
- Communicated and coordinated
- Structured but flexible
- Outcomes & milestones are defined
- Includes monitoring and feedback
- Assumptions are tested (ongoing)
- Includes ongoing risk assessment

Resources

- Expertise
- Personnel
- Money
- Equipment
- Supplies
- Competitive intelligence

Time

- Timing of key activities
- Sufficiency of time
- Time efficiency of activities
- Delays & disruptions
- Time-to-market
- Product cycle time

Environment

- Marketplace
- Competition
- Seasonal climates
- Geography
- Regulatory and legal
- Staff: interest, awareness and attitudes

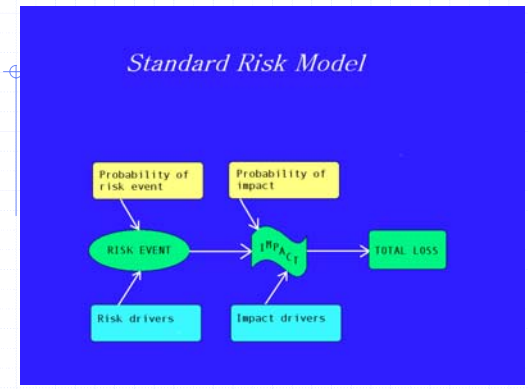
Risk Models

- Useful for discussion purposes
- Should be consensus-based
- Requires data, knowledge, experience
- Must be realistic, informed and complete

Risks

- Can occur at any stage in the project
- Risks may be anticipated or *Modeled*
- Managing risk is key
- *Events* and occurrences have *Impacts*
- *Impacts* have *Consequences*
- Research is inherently risky
- Development can be risky

Safe assumption:
the unknown carries risk

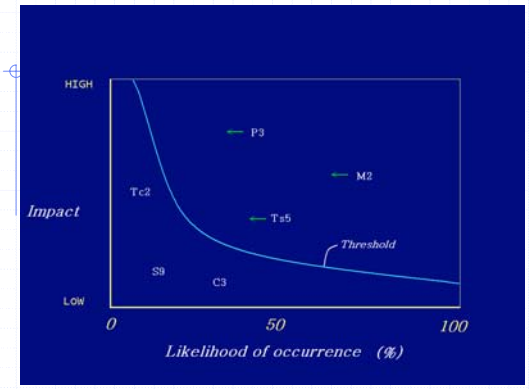


Expected Loss or Risk Exposure

$$L_e = P_e \times P_i \times L_t$$

Where:

L_e = Expected loss (seriousness of risk)
P_e = Probability of risk event
P_i = Probability of event impact
L_t = Total loss potential



Risk Drivers & Impact Drivers

- Drivers exist in the project environment
- Understanding is key
- Risk drivers suggest *Prevention Plans*
- Impact drivers suggest *Contingency Plans*

Key to managing risk:
control likelihood of risk event occurrence

Risks

- Many critical risks are cross-functional
- Focus on risks that are likely to disrupt the project schedule
- Identify risks early in the project

Risk Model Development - Steps

- Identification
- Analysis
- Prioritization
- Response Planning
- Monitoring

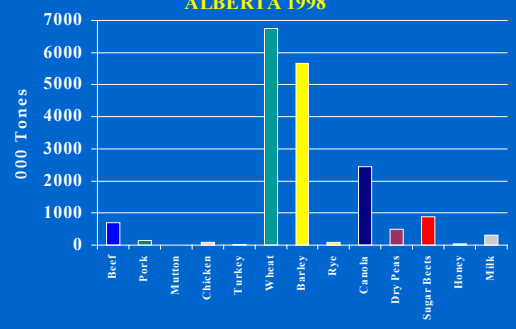
Summary

- Develop the proper project perspective
- Know the full project environment
- Define All the elements of success
- Identify All avenues to success
- Identify real & potential barriers
- Monitor assumptions, goals, plans
- Communicate fully & consult widely
- Be proactive in managing risks

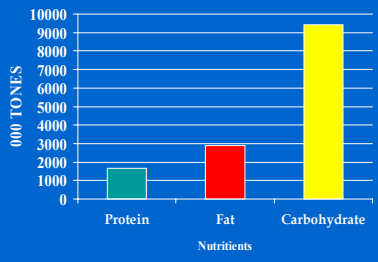
Agri-Health and Value-Added Opportunities for Alberta

Ron Pettitt
Leduc Food Processing Development Centre
Alberta Agriculture, Food and Rural Development
June, 2002

PRODUCTION OF AGRICULTURE COMMODITIES ALBERTA 1998



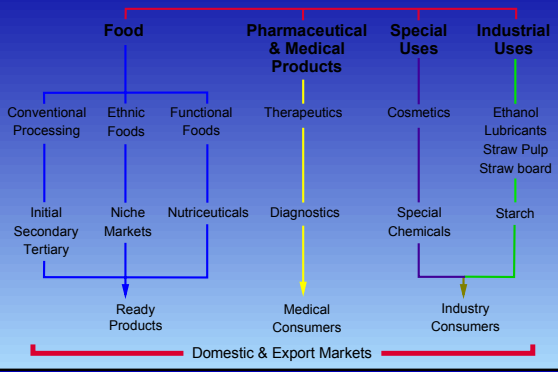
PRODUCTION OF MACRONUTRIENTS ALBERTA 1998



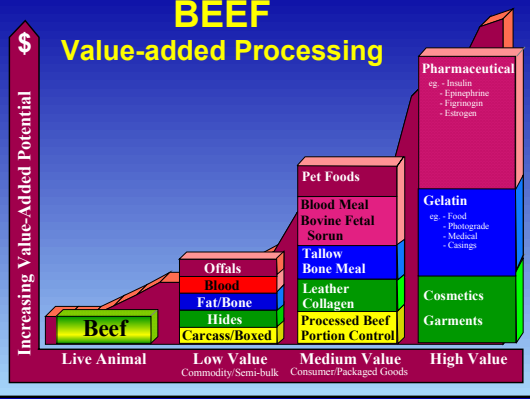
Macronutrients (1)

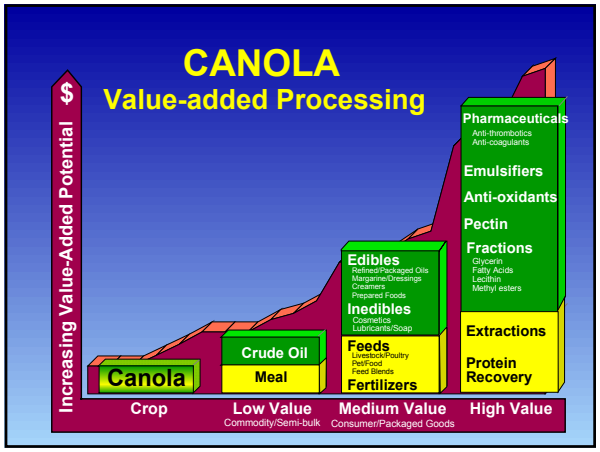
- 1,705 million tonnes of protein
- 2,899 million tonnes of fat
- 9,440 million tonnes of carbohydrate
- enough protein to sustain 85.250 million adults or 179.5 million children annually
- one Alberta farmer sustains 1,445 adults or 3,041 children annually

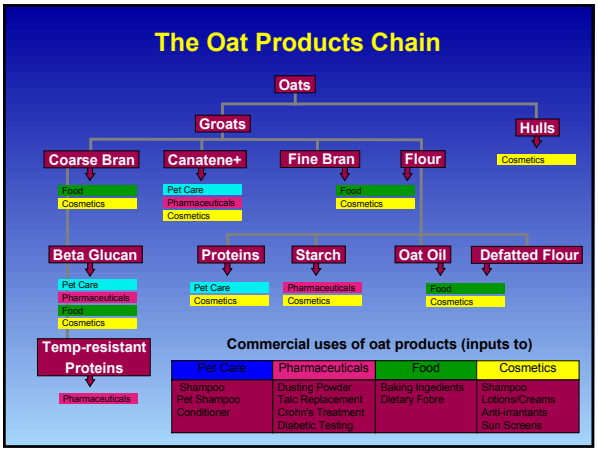
Agricultural Production: Value Added Sector



BEEF
Value-added Processing




CANOLA
Value-added Processing
Increasing Value-Added Potential $
Canola
Crude Oil
Meal
Edibles
Refined/Packaged Oils
Margarine/Dressings
Creamers
Prepared Foods
Inedibles
Cosmetics
Lubricants/Soap
Feeds
Livestock/Poultry
Pet/Food
Feed Blends
Fertilizers
Pharmaceuticals
Anti-thrombotics
Anti-coagulants
Emulsifiers
Anti-oxidants
Pectin
Fractions
Glycerin
Fatty Acids
Lecithin
Methyl esters
Extractions
Protein Recovery
Crop
Low Value
Commodity/Semi-bulk
Medium Value
Consumer/Packaged Goods
High Value


The Oat Products Chain
Oats
Groats
Hulls
Cosmetics
Coarse Bran
Food
Cosmetics
Canatene+
Pet Care
Pharmaceuticals
Cosmetics
Fine Bran
Flour
Food
Cosmetics
Beta Glucan
Pet Care
Pharmaceuticals
Food
Cosmetics
Proteins
Pet Care
Cosmetics
Starch
Pharmaceuticals
Cosmetics
Oat Oil
Food
Cosmetics
Defatted Flour
Temp-resistant Proteins
Pharmaceuticals
Commercial uses of oat products (inputs to)
Pet Care
Shampoo
Pet Shampoo
Conditioner
Pharmaceuticals
Dusting Powder
Talc Replacement
Crohn's Treatment
Diabetic Testing
Food
Baking Ingedients
Dietary Fobre
Cosmetics
Shampoo
Lotions/Creams
Anti-irrantants
Sun Screens

Functional Food for Thought - Strategic Focus in Food Safety and Probiotics

Lynn McMullen
Associate Professor
University of Alberta

Food Safety as a Continuing Issue

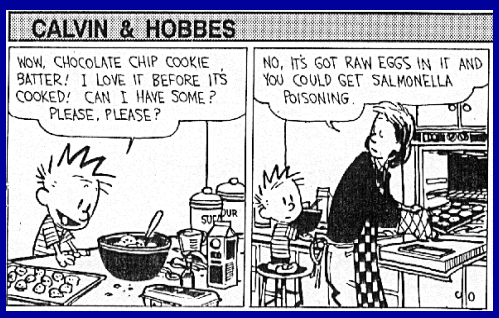
- Change is constant

Our Knowledge is your advantage
Department of Agricultural, Food and Nutritional Science

Changing Face of Foodborne Disease

- New Pathogens
  in new places

Changing Face of Foodborne Disease



Our Knowledge is your advantage
Department of Agricultural, Food and Nutritional Science

Changing Face of Foodborne Disease

- New Pathogens
  new characteristics

☛ acid tolerance
☛ antibiotic resistant pathogens

Changing Face of Foodborne Disease

- New Pathogens
- Changes in susceptibility of host population
  - as high as 25% of population is vulnerable
  - aging population
  - higher proportion immunocompromised

Changing Face of Foodborne Disease

- New Pathogens
- Changes in susceptibility of host populations
- Chronic sequalae

Chronic Sequelae

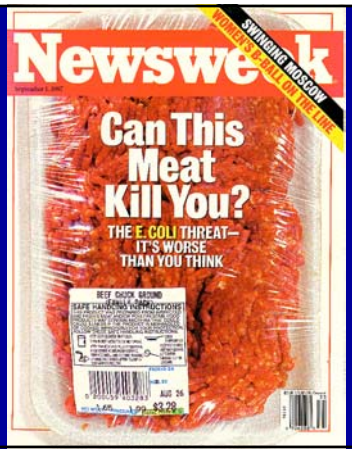
• Septic arthritis	*Salmonella* spp.
• Rheumatoid arthritis	*Yersinia, Shigella, Salmonella, Campylobacter, Escherichia* spp.
• Crohn's disease	*Mycobacterium paratuberculosis*, *E. coli, Streptococcus* spp.
• Renal disease	*E. coli* O157:H7 and others
• Guillian Barre syndrome	*Campylobacter jejuni*

Changing Face of Foodborne Disease

- New Pathogens
- Changes in susceptibility of host populations
- New food vehicles
  - minimally processed
  - fresh preservative free
  - more perishable foods

Changing Face of Foodborne Disease

- New Pathogens
- Changes in susceptibility of host populations
- Chronic sequalae
- New food vehicles
- Economic impact on the industry



SETTLEMENT CLOSES CHAPTER IN '93 HAMBURGER DEATHS

Feb. 26/98

Reuters

Bob Burgdorfer

CHICAGO -- A $58.5 million payment to Foodmaker Inc. by nine beef suppliers this week clears up nearly all claims stemming from four deaths and many illnesses in 1993 from *E.coli* tainted hamburgers.

Management of Food Safety

- HACCP
- Risk Assessment
- Food Safety Objectives as a risk management tool
  - a statement of the maximum frequency or concentration of a microbiological hazard in a food at the time of consumption that provides the appropriate level of consumer protection

Research Opportunities for the Future

- Integration of environmental surveillance with human surveillance
  - increase understanding of epidemiology and sources of foodborne disease
- Improved understanding of foodborne pathogens
  - adaptation, virulence, impact of stress responses, improved detection
    - genomics and proteomics

Research Opportunities for the Future

- Integration of environmental surveillance with human surveillance
- Improved understanding of foodborne pathogens
- Microbial ecology
  - processing and packaging technology
  - controls

Probiotic

- A live microbial feed supplement that beneficially affects the host animal by improving its intestinal microbial balance

Fuller, 1989

Prebiotic

- Non-digestible food ingredient that beneficially affects the host by selectively stimulating the growth and/or activity of one or a limited number of bacteria in the colon

Gibson and Ruberfroid, 1995

Symbiotic

- a product that contains a prebiotic and a probiotic and the prebiotic selectively favors the probiotic

Research Opportunities in Microbial Ecology of the GIT

- Fundamental understanding of microbial populations of the gut
  - influence of gut microflora on health and disease
  - influence of antimicrobials on microbial ecology, gene expression in pathogens etc.
  - influence of prebiotics, symbiotics

Research Opportunities in Microbial Ecology of the GIT

- Fundamental understanding of microbial populations of the gut
- Interaction of potential probiotic strains with gut microflora and impact on host
  - immune function
  - health benefits beyond the probiotic
    - target probiotics for disease prevention

Functional Foods & Nutraceuticals

AARI – Agri-Health and Value-Adding Strategic Research Network

June 25, 2002

Penny Mah

Outline

- Definitions
- Current Global Markets
- Market Opportunities

Definitions

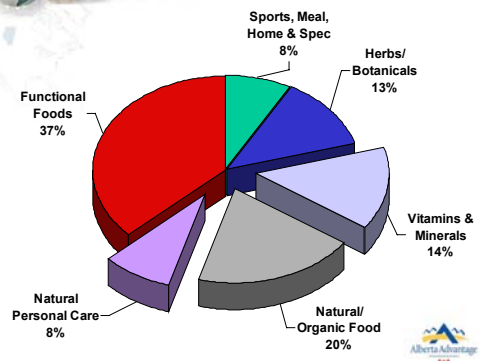
- A **functional food** is similar in appearance to, or may be, a conventional food, is consumed as part of a usual diet, and is demonstrated to have physiological benefits and/or reduce the risk of chronic disease beyond basic nutritional functions.

Definitions

- A **nutraceutical** is a product isolated or purified from foods that is generally sold in medicinal forms not usually associated with food.
- A **nutraceutical** is demonstrated to have a physiological benefit or provide protection against chronic disease.

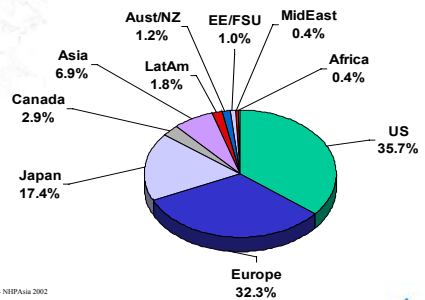
- Source: Health Canada Policy Paper on Nutraceuticals/Functional Foods and Health Claims on Foods 1998 http://www.hc-sx.gc.ca/hpb-dgps/therapeut/index.html

$150B Global Nutrition Industry 2001



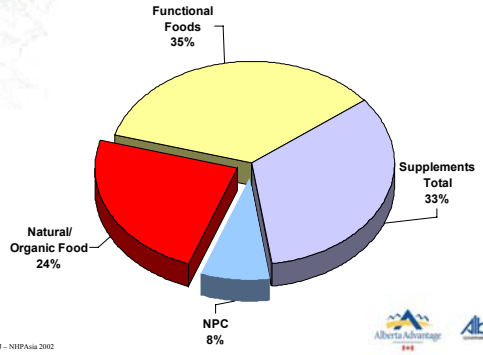
Source: NBJ – NHPAsia 2002

$150B Global Nutrition Industry 2001



Source: NBJ – NHPAsia 2002

$53B U.S. Nutrition Industry by Products in 2001



Source: NBJ – NHPAsia 2002

Market Opportunities

Market Opportunities

- **Food as Medicine**
  - 57% believe eating healthy is more effective to managing illness than medication
  - 58% greatly believe one can reduce the risk of disease by diet

Source: Nutracon 2002

Market Opportunities

- **Self-Treatment on the Rise**
  - 9/10 consumers admit to trying to self-treat common conditions in the past year
  - 96% were confident, 56% were very confident
  - 73% prefer to self-treat, 62% want to do more in the future, 94% did last year

Source: Nutracon 2002

Market Opportunities

- **Shifting Health Priorities**
  - Consumer concerns
  - Projected health issues

Consumer Concerns

- Healthy eyesight
- Heart disease
- Cancer
- High Blood Pressure
- Joint/Bone Health
- Stress
- Fatigue/Energy
- Diabetes
- Blood Triglycerides
- Headaches
- Obesity
- Acuity and Alertness

Source: Nutracon 2002

Health Problems with Above Avg. Projected Growth 1999-2010

• Menopausal women	21.1%
• Prostrate problems – men	19.8
• Heart disease	19.6
• Diabetes	19.4
• Arthritis	19.0
• Osteoporosis	19.0
• High blood pressure	18.8
• High cholesterol	18.7
• Cancer	18.2
• Eyesight	15.2
• Obesity	13.8

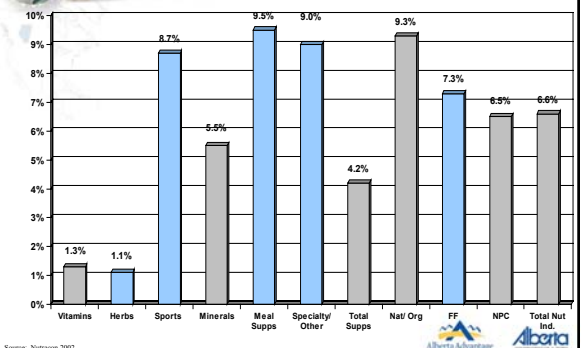
Source: Nutracon 2002

Natural Retailers' Dietary Supplement Top Ten List

Rank	2000	2001
1	MSM	Weight loss
2	Glucosmine/chondritin	Bone & Joint
3	SAM-e	Enzymes/co-enzymes
4	IP-6	MSM
5	Diet/Weight loss	Multi-vitamins
6	Green foods	Green foods
7	Olive Leaf Extract	Immune Boosters
8	Soy Supplements	Beta glucan
9	Alpha-lipoic acid	Growth hormone
10	Vitamin E	Soy isoflav, colostrum

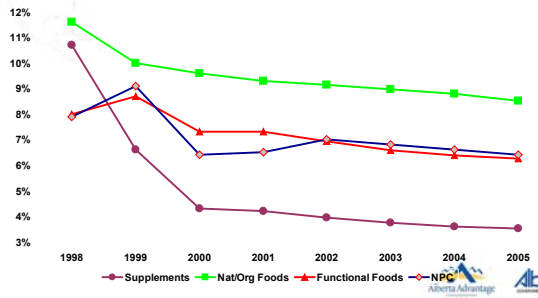
Source: Nutracon 2002

Relevant 2001 U.S. Growth Rates



Source: Nutracon 2002

U.S. Nutrition Ind. Growth Rates 1998 - 2005e



Source: Nutracon 2002

Future

- The functional foods and nutraceutical sector will prosper with strong science backing products that are effective, safe and in demand.

foragen

Agri-Health & Value-Adding Strategic Research Network

Armand Lavoie
Vice President Western Canada
Foragen Technologies Management Inc.

June 25, 2002

Foragen Overview

- A Company Creation Vehicle
- Focus on Advanced Agricultural and Food Technologies
- $42M fund
- Provide initial seed investment: $500K to 1.5M
- Max total investment: $3M
- Investment horizon: 5 to 7 years
- IRR: > 25% after tax (overall Foragen's performance)

foragen

Foragen Strategic Priorities

- Human and Animal Health
- Alternatives Bio-Based Products/Materials/Process
- Food Safety - a 21st Century priority
- Tools for enhancement of efficiency /production
- Environmental sustainability
- Food and Fibre Quality/Traits enhancement
- "Freedom to Operate" - Platform technologies

foragen

Foragen Investment Requirements

- Product concept
  - Differentiating advantage
- Unmet need
- Large market
- Patentable technology
- Freedom to operate
- Platform technology
- RETURN ON INVESTMENT

foragen

Foragen Due Diligence (I)

- **Assessing the People**
  - Ability to work together
  - Understand their strengths and weaknesses
  - Relationship built on trust
  - Capable of delivering results
  - Open to adding to the team
- **Assessing the Technology**
  - Intellectual property
  - Proof-of-concept
  - Unique selling feature
  - Development plan

foragen

Foragen Due Diligence (II)

- Assessing the Market
  - Need for the product
  - Market size
  - Pricing and gross margin
  - Competitors
- Assessing the Finances
  - Use of funds
  - Establishing the assumptions
  - Financial projections
  - VALUATION!!!

foragen

Common Thread in Foragen Investments

- Technology often results from strategic research initiatives
- Strong key scientists
  - Excellent science
  - Think creatively (often a paradigm shift)
  - Excellent to work with
- Never a clear winning investment
  - Are the elements of success present?
- Key is to foster success by providing key elements
- Science and medical faculties are also good sources of technologies
- Feedback from end-users is key

foragen

Foragen Sees a Strong Potential for Company Creation

- 20 to 40 companies
- Between $50 and $200 M sales
- Global companies
- Headquartered locally
- Strong manufacturing presence
- Opportunities in both main commodity and specialized crops adapted locally

foragen

Foragen Sees Many Other Technologies With Potential

- Not all technologies are company creation
  - Licensing plays
  - Good profitable companies with limited growth potential
- Potential for 100 to 200 co. with sales between $5 and $50 million
  - Product development is key for their success

foragen

Questions

Thank You

Wheat Bioproducts

Canadian Wheat Cultivar Development Network

AAFC Cereal Research Centre
June 4 - 5, 2002

Stewart J. Campbell
PhD, MBA, PAg.

S. J. Campbell Investments Ltd.
Cochrane, Alberta sjc@bizinc.com

Whither Wheat Bioproducts?

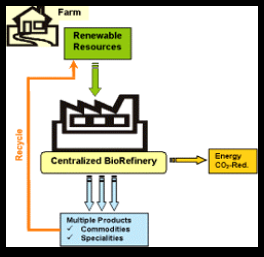
Look to the corn refining business :

- Early on - a US economic development instrument !
- Today - a global industrial bioproducts engine !
- Wheat refining - a business model for Canada ?
- What's the same?
- What's different?

Products Used by A Myriad of Industries

GLOBAL Bio-Chem Technology Group Company Limited 大成生化科技集團有限公司

What will it take to build Canada's bioeconomy?



- **Strategic focus**
- **Srategic alliances**
- **Simultaneous discovery**
- **Novel genetics**
- **Novel processing**
- **Novel products**
- **Commitment - long term**
- **Risk capacity**
- **Public appreciation of science**

Current & Potential Biomass Feedstocks

Crops

Corn **Wheat**
Potato **Barley**
Sorghum **Sugar Cane**
Milling byproducts

Cellulose / Hemicellulose

Forest residue **Sawdust**
Cereal straw **Corn fibre**
Yard clippings **MSW**
Industrial Hemp **Populars**

Food and Beverage Wastes

Beer **Used frying oils**
Cheese whey **Food processing wastes**
Corn syrup **Fruit juices / drinks**

Canada's Bioproducts Feedstock

Bioresource	Production	Domestic Use	Available for Bioproducts
Forest Products			
Lumber	68.4 million cubic meters		
Wood pulp	25.3 million tonnes shipped world-wide		
Newsprint	9.2 million tonnes		
Commercial forest	234.5 million hectares		
Sawmill Residue[18]			1,100,000
Cereals[19]	million tonne in 1999/2000 crop year		
Wheat – all classes	26,900,000	8,643,000	18,257,000
Barley – all classes	13,196,000	10,503,000	2,693,000
Corn	9,161,000	8,991,000	170,000
Oats	3,641,000	2,104,000	1,537,000
Rye	387,000	310,000	77,000
Oilseeds			
Canola – all classes	8,798,000	3,597,000	5,201,000
Flax – all classes	1,022,000	226,000	796,000
Soybean – all classes	2,781,000	2,271,000	510,000
Pulses and Specialty Crops			
All species and classes	4,074,000	1,392,000	2,682,000
Agricultural Fibre Crops and Residues			
Industrial hemp, others			Not known
Straw, others			20,000,000

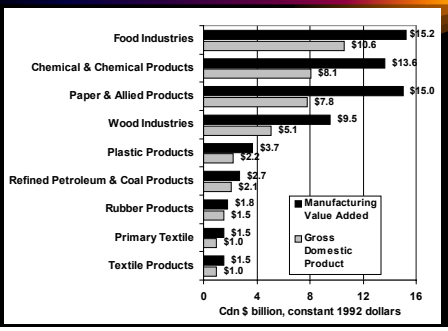
Canada's Present Bioproducts

Bioproduct	Application	Present Contribution
Biomass energy	Combustion of wood residues and pulping liquor	7% of Canadian energy supply
Biofuels	Corn, wheat and barley starch fermentation	175 million litre / year of fuel ethanol. 0.3% of gasoline energy.
Biodiesel	Conversion of waste vegetable oil and animal fats	Pilot demonstration plant producing 1 million litre/year.

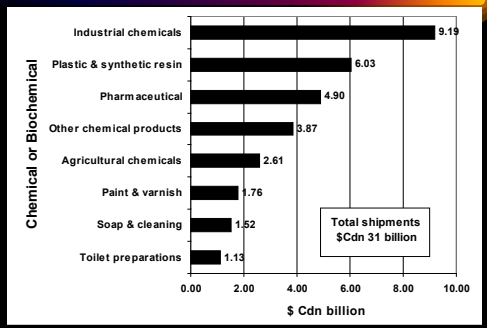
A River of Products !

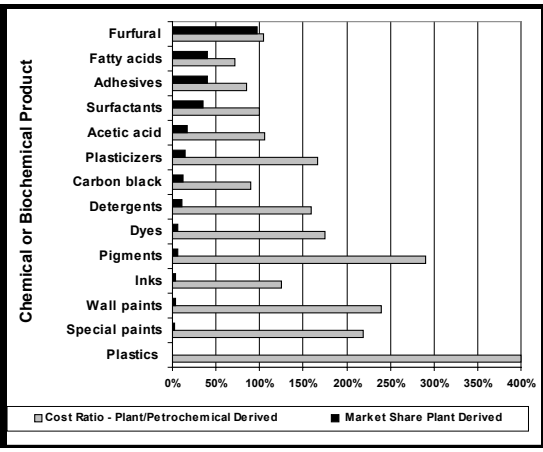
Archer Daniel Midland

Whose to Use Wheat Bioproducts ?
Canada's Manufacturers

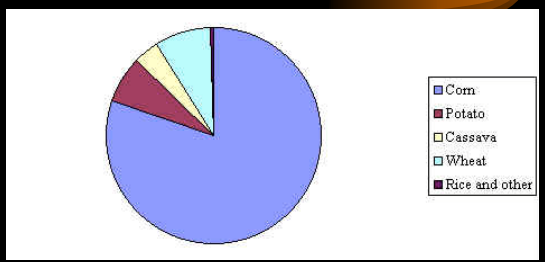


Canada's Chemical & Chemical Products Industry

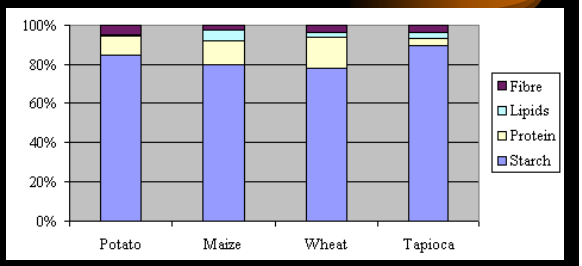


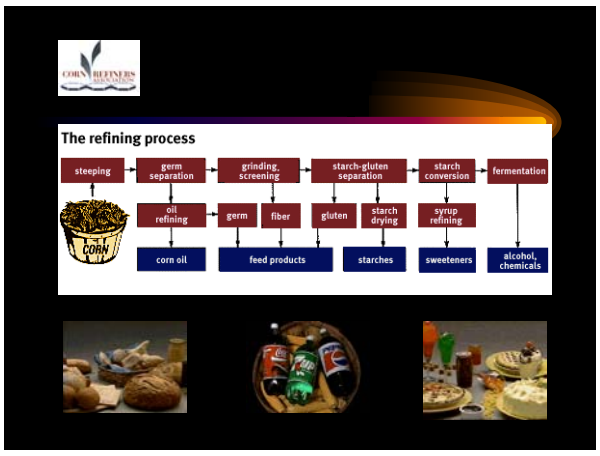


Sources of Starch
Used in World Carbohydrate Economy

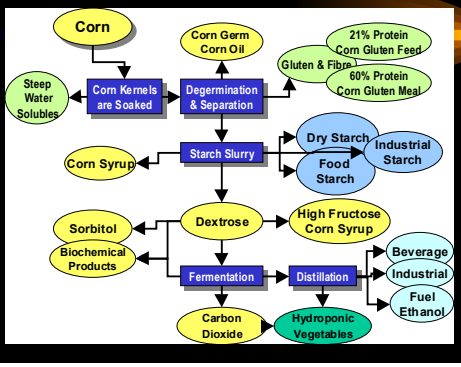


Composition of Starch Crops
dry basis

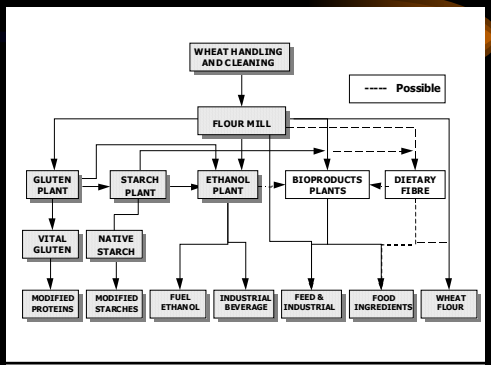




Total Material Utilization



Wheat Refining



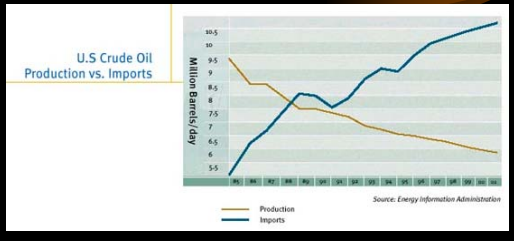
Simultaneous Discovery

Frame Breaking !

- Plant biotechnology
- Agricultural & equipment engineering
- Upstream processing
  - biocatalysis, metabolic engineering, biomass conversion, bioreactor design and cell culturing,
- Downstream processing
  - separation, purification, biorefining, processing monitoring and control
- Biomaterial processing
- Systems Integration

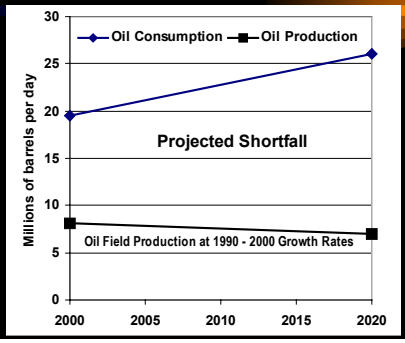
The "X" Factor

Why the US Government Supports Bioenergy



The US Petroleum Deficit

Determining driver ?



Economic Arguments
US Government Support of Ethanol

Positive Impact of Ethanol Program on Federal Budget

Type of Revenue Gain/Loss	$ Millions
Personal Income Taxes, Wages, Salaries	532
Personal Income Taxes, Farm Income	675
Social Security Taxes	1,608
Decline in Unemployment Benefits Aid	561
Corporate Income Taxes	846
Less Ethanol Tax Incentive	-648
Annual Savings to Federal Budget	$ 3,574

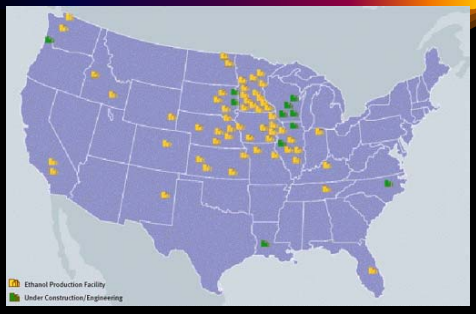
Source: "The Economic Impact of the Demand for Ethanol," Dr. Michael K. Evans, Kellogg School of Management

Environmental Drivers
US Government Support of Ethanol

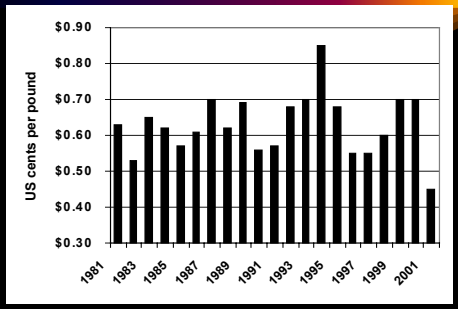
Ethanol Reduces Greenhouse Gases:

Growth of Fuel Ethanol in US

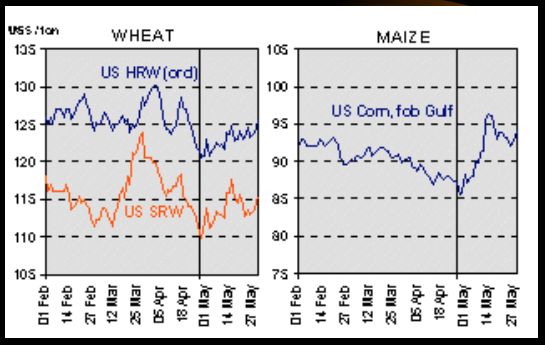
Ethanol Plants in US
Many more on the drawing boards



NAFTA Wheat Gluten Price ↓
Permanently depressed due to EU starch policy?



Cost of Goods



Cost Price Risk

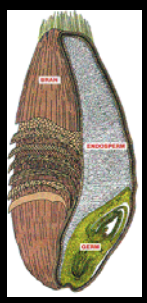
Cost of Natural Gas

Focus for R&D ?

• Significant traits…….. …..	CPS OK, novel - let's see
• Grain yield & cost of goods ……	Must improve versus corn
• Total material utilization …….	Yes, yield x unit selling $
• Fractionation ……..	Probably OK, import, adapt
• Extraction / purification……	Probably OK, import, adapt
• Phys / chem modification ……..	Import, adapt, develop novel
• Structure - function …….....	Validate, adapt, novel
• Process engineering ……..	Import, adapt, develop novel
• Utilization ……..	Much work needed
• Industry/venture business case.	Need proof of concept
• Value chain ……..	Much work needed

Key Results Expected of R&D $

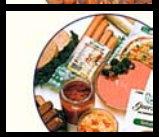
Relieve constraints and create opportunities



- New significant traits
- Competitive yield / cost
- Process engineering
  - = fractionation
  - = isolation / purification
  - = total material utilization
  - = phys / chem modification
- Structure - function
- Utilization - product development
- Market / value chain development

Wheat Ingredients Business

Food, Feed & Cosmetics



Industrial Bioproducts

- Biochemicals
- Biopolymers
- Biocomposites
- Biofuels