Prospectives of Economically Efficient Bioethanol Production in Armenia

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What is Bioethanol?

- The principle fuel used as a petrol substitute is bioethanol
- Bioethanol fuel is mainly produced by the sugar or cellulose fermentation process
- Ethanol is a high octane fuel and has replaced lead as an octane enhancer in petrol
- The most common blend is 10% ethanol and 90% petrol (E10
- Bioethanol is an alternative to gasoline for flexifuel vehicles

What are the benefits of Bioethanol?

- Bioethanol comes from a renewable resource
- Bioethanol is biodegradable and far less toxic that fossil fuels
- Benefit over fossil fuels is the greenhouse gas emissions reduced
- Bioethanol can be easily integrated into the existing road transport fuel system
- Blending bioethanol with petrol will ensure greater fuel security, avoiding heavy reliance on oil producing nations

The **top** five ethanol producers in 2005 were:

Brazil - 16500 billion liters

The United States -16270 billion liters

China - 2000 billion liters

The European Union - 950 billion liters

India - 300 billion liters

Bioethanol production and consumption in EU (2007)

	Production	Consumption	(million)liters
Germany	431	3 573	
Sweden	140	1 895	
France	250	1 747	
Spain	402	1332	
Austria	150	920	
Poland	120	611	
UK	205	561	
Finland	0	9	

Bioethanol proportion in fuel consumption

Brazil - 25% (2005)

EU - 5.75% (2010)

China - 5% (2010)

Thailand - 10% (2010)

USA - 5% (2010), 30% (2030)

Japan - 5% (2010)

4 000 000 vehicles in Brazil use pure ethanol !

Bioethanol Production

- Ethanol can be produced from a variety of feedstocks such as sugar cane, bagasse, sugar beet, switchgrass, potatoes, fruit, molasses corn, stover, wheat, straw, other biomass, as well as many types of cellulose waste and harvestings

- Agricultural feedstocks are considered renewable because they get energy from the sun using photosynthesis

Cornfield in South Africa

Sugar cane harvest

Switchgrass

Sugar Beet	Jerusalem Artichoke	Spoiled Fruits
Sugar Cane	Chicory	Sugar Factory Waste
Feed Corn	Sweet Potatoes	Trees from Forests
Wheat	Sweet Sorghum	Grain Straw
Barely, Rye, and Oats	Cheese Production Waste	Hybrid Poplar
Potatoes	Wine Production Waste	Willow Trees
Fruits	Fruit and Canning Waste	Mulberry Trees

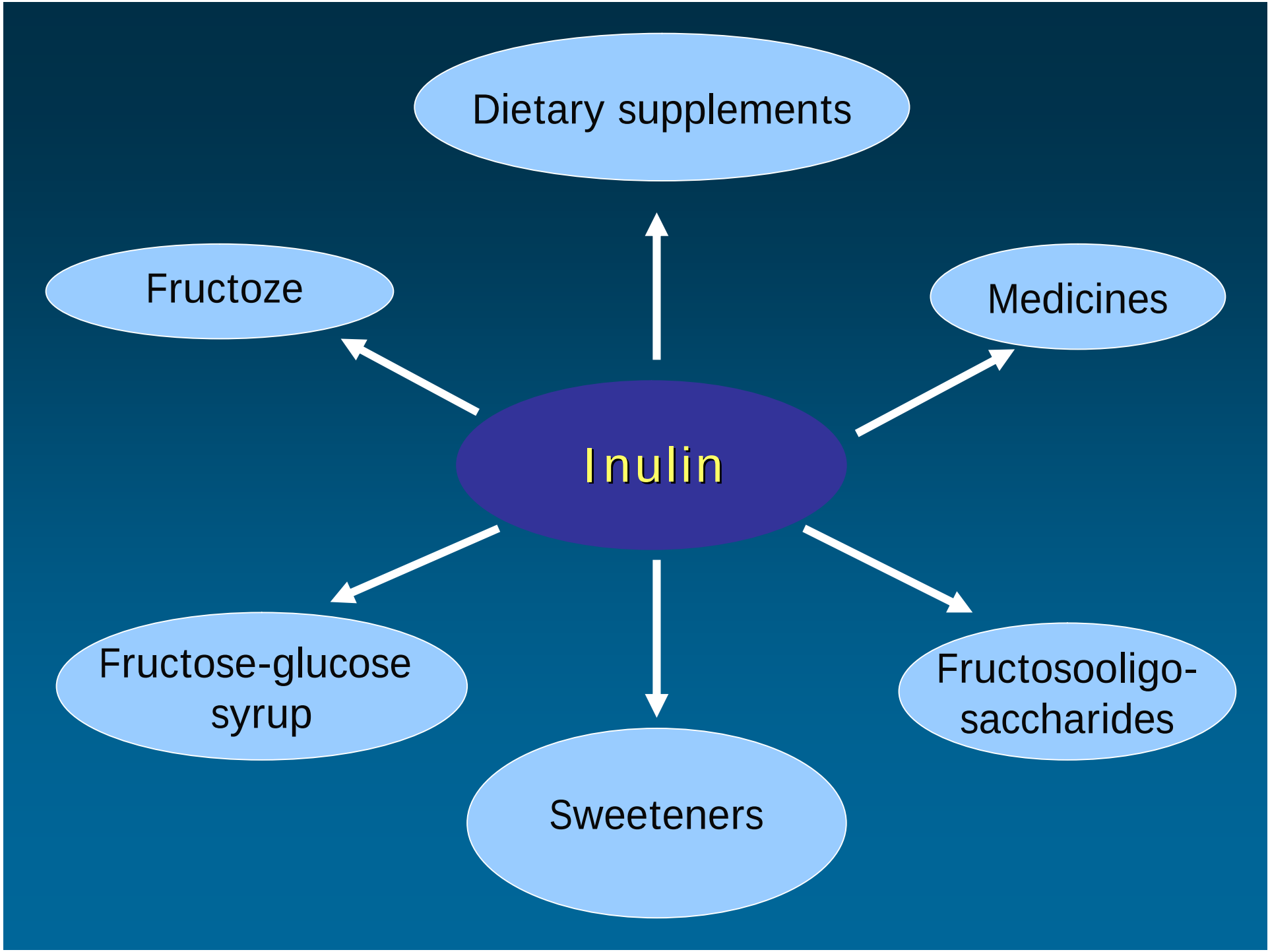
The basic steps for large-scale production of ethanol

- Microbial (yeast) fermentation of sugars
- Distillation
- Dehydration
- Denaturing

Prior to fermentation, some crops require saccarification or hydrolysis into carbohydrates.

Jerusalem artichoke

- Jerusalem artichoke is a hardy and low-input crop, demanding little in terms of soil and water and able to grow under a wide range of weather conditions
- Average crop yield is up to 70 000 kg of tubers per ha and year
- Average ethanol production is 5,708 l per ha (1.7, 2.0 and 3.7 tames more than from sugar beet, corn and wheat, respectively)
- Green biomass (yield: 50 -60 ton per ha) is a perfect feed for cattle
- Inulin is a source of different chemicals


Dietary supplements
Fructoze
Medicines
Inulin
Fructose-glucose syrup
Fructosooligo-saccharides
Sweeteners

FEEDSTOCK PRODUCTION			
yield	60,000	kg tubers per ha	
inulin content	16%	w/w	
ethanol yield	0.095	l per kg tuber	
ethanol production	5714	l per ha	
crop production costs	$1,230	per ha	
Feedstock production cost	**$0.22**	**per l ethanol**	
DISTILLERY			
variable costs	$0.11	per l ethanol	
fixed cost	$0.04	per l ethanol	
Operational cost	**$0.14**	**per l ethanol**	
Total Production Cost	**$0.36**	**per l ethanol**	
CREDITS			
distillery refuse yield	4	l per l ethanol	
distillery refuse cost	($0.01)	per l	
distillery refuse credit	**($0.03)**	**per l ethanol**	
green biomass yield	0.857143	kg per kg tubers	
green biomass cost	($0.02)	per kg	
green biomass credit	**($0.14)**	**per l ethanol**	
Total Credits	**($0.17)**	**per l ethanol**	
FINAL ETHANOL COST	**$0.19**	**per l ethanol**	

Evaluation of The Economic Effectiveness of Using the Jerusalem Artichoke for Production of Bioethanol

The financial analysis set the return on investment at 15% and solved for the cost of the two bio-ethanol feedstocks that would guarantee this return

Jerusalem artichoke can be purchased for a maximum of $88.52 per ton 27 AMD per kg) / using an average bio-ethanol price of $1.34 per liter (410 AMD per liter)/.

Feed corn must be purchased for less than or equal to $393 per ton (Armenia import costs for corn in 2008 have been around $400/ton)

Conclusion

- Manufacture of bioethanol in Armenia would considerably improve the country energy security by reducing its reliance on foreign oil.
- A growing ethanol industry will provide jobs in plant operations and maintenance and contribute to rural economic development.
- Jerusalem artichoke is one of the most-likely candidates for use as a raw material for industrial production of bioethanol
- Such production can be effective and profitable in Armenia if special tax for hydrocarbons will be completely removed from bioethanol.

Thank you