Applications of Stevia rebaudiana in Agriculture and Stockbreeding

JBB STEVIA LABORATORY/B&L corporation
Shintaro Kimura
Overview of Stevia Applications in Japan

- **1970**: *Stevia rebaudiana* introduced to Japan → Trial cultivation started
- **1975**: Mr. N. Sato, JBB President, focused on big potentials of *Stevia rebaudiana* for non-sweetener applications
- **1982**: He started research on *Stevia r.* → production of Stevia hot-water fermented extract
- **1988**: He established JBB Stevia Laboratory → studied effect-efficacy of *Stevia r.*, and commercialized Stevia products for many applications
- **2005**: B&L Corporation was incorporated for further expansion of Stevia potentialities.

R&D and commercialization for *Stevia Extract & Powder* by Sweetener makers

- Agriculture
- Stockbreeding
- Fishery
- Forestry
- Cosmetics
- Pets
- Health
- Echo
Applications & Effect-efficacy of Stevia

**Agri-culture**
- Quality & sugar content UP
- Less agrochemical residues
- Nitrate-reducing activity
- Anti-fungus activity
- Longer freshness
- More crop
- Better budding & rooting

**Fishery**
- Fish meat quality UP
- Histamine detoxifying
- Hypoxia tolerance UP

**Stock-breeding**
- Less meat odor
- Meat quality UP
- More egg collection
- Faster growth of chicks
- Estrus & conception rate UP

**Health**
- Antioxidizing power
- Bactericidal activity
- Anti-virus activity
- Anti-diabetes activity
- Histamine detoxifying
- Antihelicobacter pylori
- Antioxidizing power
- Anti-aging activity
- Anti-atopy activity
- Moisturizing effect

**Beauty**
- Antioxidizing power
- Anti-aging activity
- Anti-atopy activity
- Moisturizing effect
Agro. I  Products & effects - Stevia farming

Stevia agro-products

- **Liquid fertilizer**
  A hot-water fermented extract from Stevia stems & leaves
  - Foliar spray in dilution
  - Aspersion into farm soil
  - Anti-oxidizing products
  - Less agro-chemical residues
  - Less nitrate content
  - Better taste
  - More nutrition

- **Powder & pellet fertilizers**
  powdered & pelleted from Stevia stems & leaves

- **Stevia compost**
  made of Stevia powder & animal dung
  - Mixed into farm soil
  - Activates microbes in soil
  - Activates budding & rooting
  - Less agro-chemical & nitrate
  - More crop

Delicious, safe & secure, stay-fresh-longer farm products
Agro. II  Effect I - Better product quality

Stays fresh longer  

< Shelf life test on strawberries >  
Test in Ibaragi  
From Jan. 11 ~ 17, 2000

○ Edible, △ Not edible, × Unusable

<table>
<thead>
<tr>
<th>Test items</th>
<th>Elapsed number of days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Stevia-applied</td>
<td></td>
</tr>
<tr>
<td>Color</td>
<td>○</td>
</tr>
<tr>
<td>Damage</td>
<td>○</td>
</tr>
<tr>
<td>Turn moldy (%)</td>
<td>0</td>
</tr>
<tr>
<td>Non-Stevia</td>
<td></td>
</tr>
<tr>
<td>Color</td>
<td>○</td>
</tr>
<tr>
<td>Damage</td>
<td>○</td>
</tr>
<tr>
<td>Turn moldy (%)</td>
<td>0</td>
</tr>
</tbody>
</table>

Higher sugar content  

Comparison in sugar content between Stevia-applied & non-Stevia

<table>
<thead>
<tr>
<th>Samples</th>
<th>Sugar Content (°Brix)</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stevia-applied</td>
<td>Non-Stevia</td>
</tr>
<tr>
<td>Strawberry</td>
<td>12.9</td>
<td>9.5</td>
</tr>
<tr>
<td>Tomato</td>
<td>6.8</td>
<td>5.9</td>
</tr>
<tr>
<td>Peach</td>
<td>13.7</td>
<td>12.9</td>
</tr>
<tr>
<td>Grape</td>
<td>18.2</td>
<td>16.6</td>
</tr>
</tbody>
</table>
Shelf life test (by NHK Broadcasting)

Test on pears: Image extracted from NHK TV aired on Sep. 29, 2003

After 20 hours

Stevia-cultivated pear
Non-Stevia pear

Much less change in color for Stevia-cultivated pear which has more resistance against oxidization.
Agro. III  Effect II - Higher safety

No agro-chem. residues

Comparison test on lemons in agro-chem residue

Examination on pesticide performed by Tokyo Metropolitan Clinical Laboratory
Detection limit: 0.01 ppm
Test samples: Stevia-cultivated lemons

<table>
<thead>
<tr>
<th>Stevia products &amp; agro-chem. Applied</th>
<th>Agro-chemicals</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec. 2000: Stevia compost</td>
<td>Organochlorine pesticide</td>
<td>ND</td>
</tr>
<tr>
<td></td>
<td>Organophosphorous pesticide</td>
<td>ND</td>
</tr>
<tr>
<td>Mar. 2001: Farm A application</td>
<td>Carbamate pesticide</td>
<td>ND</td>
</tr>
<tr>
<td>April: Agro-chemicals</td>
<td>Captan pesticide</td>
<td>ND</td>
</tr>
<tr>
<td>May: Agro-chemicals</td>
<td>Ortho phenyl phenol</td>
<td>ND</td>
</tr>
<tr>
<td>July: Agro-chemicals</td>
<td>Diphenyl</td>
<td>ND</td>
</tr>
<tr>
<td>August: Harvest start</td>
<td>Thiabendazole</td>
<td>ND</td>
</tr>
<tr>
<td>September: Farm A application</td>
<td>Imazalyl</td>
<td>ND</td>
</tr>
</tbody>
</table>

Reduction in nitrate

Comparison test on carrots in nitrate content

Test performed in 2005
JA1-1 etc. show test sections.
- Stevia-cultivated
- Non-Stevia
Agro. IV  Effect III-Faster growth · more crop

Comparison in growth of carrots:
Cultivated in 2005 at Miyazaki
N.B. 1 ~ 10 : Test section number

Comparison in length of carrot roots:
Stevia-cultivated carrot
Non-Stevia carrot

Comparison in weight of carrots:
Cultivated in 2005 at Miyazaki
N.B. 1 ~ 10 : Test section number

Growth promoting effect

More crop
Agro. V Effect IV- Soil improvement / Promotion of budding & rooting

Activates useful microbes in farm soil

Exhausted soil → Stevia application → Bacterial growth → Multiplied useful microbes make soil into aggregate structure

Promotes rooting

Rice plants

- Germination rate UP
- Uniform growth
- Growth promotion
- Nutrient absorption ability UP
- More resistant to disease

Farm plants full of nutrients & resistant to diseases
Agro. VI Stevia farm products - Markets in Japan

Market size for Stevia farm products
US$100 ~ 200 Mil/year

Sales channels of high-end farm products

- Marketed at high prices in high-end fruit specialty stores
- Stores specializing in Stevia farm products are prevailing.

Highly-acclaimed in fruit & vegetable markets

- High evaluation with certification marks in the 2 biggest markets in Japan
- Permanent corner in the market specializing in sales of Stevia farm products

Super-deluxe fruit store Stevia product specialty store
Certification mark
1998・Published a paper on anti-oxidizing activity of Stevia & its utilization

2002・B&L Stevia agricultural products were certified as a farming material conforming to organic cultivation.
  ・Presented in a congress a paper on the effect of Stevia on germination & rooting

2003・Presented in a congress papers on identification of high-temperature bacteria & lactic acid bacteria in Stevia powder

2004・Presented in a congress a paper on the effect of Stevia compost for rooting

2006・Presented in a congress a paper on nitrate-decreasing power & agro-chemical dissolution by Stevia

2007・A paper on antifungal activity of Stevia

Joint research institutes in agriculture
  ◇ Department of Applied Microbiology, Fukuoka Junior College of Agriculture
  Research on agro-chem. residues, nitrate content, more crop, etc.
  ◇ Faculty of Engineering, Shizuoka Univ.,
  Research on high-performance compost manufacture
  ◇ Kanagawa Pref. Agriculture Technology Center, Research on farm plant growth
Breeding I  Products & effects

Stevia stockbreeding products

- **Powder product**
  powdered from Stevia stems & leaves
  Mixed into feedstuff

- **Liquid extract product**
  A hot-water fermented extract from Stevia stems & leaves
  Mixed into drinking water

- Faster growth of chicks
- Increase in immunizing power
- More egg collection
- Less egg breakage

- Estrus & conception rate UP
  Faster growth
  Healthy growth
  Increase in immunizing power
  Enhanced appetite

- Faster growth
  Increase in immunizing power
  Enhanced appetite
  Better meat quality
  (less dripping of meat juice, less animal odor)
Breeding II Effect I - Growth promotion

**Growth promoting effect of FSEL* on broiler chicken**

Comparison in weight change trend

<table>
<thead>
<tr>
<th>Weeks</th>
<th>Body weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>200</td>
</tr>
<tr>
<td>3</td>
<td>300</td>
</tr>
<tr>
<td>4</td>
<td>400</td>
</tr>
</tbody>
</table>

- **STV group**: fed with feedstuff with Stevia powder 0.2% mixed
- **Control group**: fed with feedstuff only
- **Testing period**: 1 month

*Fermented Stevia Extract Liquid*

**Growth promoting effect of FSEL* on beef cattle**

Comparison in weight change

- **STV group**: fed with water with Stevia liquid 0.2% mixed
- **Control group**: fed with feedstuff with Stevia powder 0.2% mixed

*Fermented Stevia Extract Liquid*
Promotion of estrus & conception of Japanese Black Cattle

Stevia powder was fed to 15 cows which showed no signs of estrus for a certain period after delivery.

How to administer: Stevia powder 30g each mixed into feedstuff every morning and evening

The cows that came into rut and became pregnant within 20 days after start of Stevia administration

The cows that came into rut and became pregnant within 50 days after start of Stevia administration

<table>
<thead>
<tr>
<th>Cow No.</th>
<th>Length of infecundity (days)</th>
<th>Days to fertilization (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>127</td>
<td>11</td>
</tr>
<tr>
<td>B</td>
<td>130</td>
<td>16</td>
</tr>
<tr>
<td>C</td>
<td>178</td>
<td>17</td>
</tr>
<tr>
<td>D</td>
<td>120</td>
<td>32</td>
</tr>
<tr>
<td>E</td>
<td>138</td>
<td>25</td>
</tr>
<tr>
<td>F</td>
<td>60</td>
<td>31</td>
</tr>
<tr>
<td>G</td>
<td>70</td>
<td>17</td>
</tr>
<tr>
<td>H</td>
<td>150</td>
<td>-</td>
</tr>
<tr>
<td>I</td>
<td>74</td>
<td>46</td>
</tr>
<tr>
<td>J</td>
<td>118</td>
<td>24</td>
</tr>
<tr>
<td>K</td>
<td>90</td>
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</tr>
<tr>
<td>L</td>
<td>117</td>
<td>35</td>
</tr>
<tr>
<td>M</td>
<td>63</td>
<td>12</td>
</tr>
<tr>
<td>N</td>
<td>88</td>
<td>14</td>
</tr>
<tr>
<td>O</td>
<td>90</td>
<td>23</td>
</tr>
</tbody>
</table>
Breeding IV Effect III - Enhancement of immunizing power

Selective bactericidal activity

Inhibitory effect of FSEL* on avian influenza infection


*Fermented Stevia Extract Liquid

By Kazuo Takahashi, M.D., Dr. Med. Sci., Sep. 2006
Breeding V  Marketing - By product branding

Features of Stevia-grown pork

◇ Delicious & juicy
◇ Refreshing & rich taste
◇ No unwanted odor
◇ Stays fresh longer
◇ No meat juice dripping
◇ Internal organs look nice & pinky.

Pork under the brand of “Momoh”

◇ Produced from Stevia-bred pigs
◇ Contains twice as much calcium as ordinary black pig pork.
◇ Contains DHA. ↓

Differentiated marketing

◇ Sales channel: mass retailers
Technologies & know-how for Stevia utilization in agriculture & stockbreeding

**Manufacturing technology of Stevia extract**
To condense, extract, ferment and age Stevia plants into extract liquid which produces effects in human health, agriculture and stockbreeding

**Manufacturing technology of Stevia agro-materials**
To mix Stevia extract and powder of Stevia stems and leaves into agricultural materials which produce remarkable effects on farm plants

**Stevia compost manufacturing technologies**
To manufacture high-performance Stevia compost with Stevia manure materials mixed. Know-how accumulated on site & scientific data

**Application know-how for Stevia agro-materials**
Know-how to cultivate farm plants with Stevia agro-materials, and scientific data from test institutions. High-quality certification marks.
Thank you very much.