# THESES OF DOCTORAL (PhD) DISSERTATION

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# COMPARATIVE EVALUATION OF CONVENTIONAL PLATING METHODS FOR SELECTIVE ENUMERATION OF LACTIC ACID BACTERIA AND BIFIDOBACTERIA AND THEIR APPLICATION IN MICROBIOLOGICAL QUALITY CONTROL OF FERMENTED MILKS

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# 1. INTRODUCTION AND AIMS

Probiotics are live microorganisms (mostly bacteria) which when administered in adequate amounts confer a health benefit on the host. The therapeutic effects exerted by probiotic bacteria are dependent on the number of viable microbial cells reaching the human gut.

The commercially available probiotic products are made by addition of various bacterial cultures. The selective enumeration of these bacteria raises numerous questions, because in the international scientific papers often controversial statements can be found about the conditions of selective enumeration (i.e., composition of media, incubation temperature and time, aerobic/anaerobic atmosphere).

Although bovine milk production represents ca. four fifths (770 million ton) of the global milk production, milking animals are not limited to cows in many parts of the world and, thus, goat (2,4%), sheep (1,3%), and camel (0,4%) milks are also available in significant quantities. Each of these milks is suitable for the production of probiotic fermented dairy products. Every mammal species has a unique milk composition and this may influence the growth and survival rates of lactobacilli and bifidobacteria.

Consumer interest in camel milk is increasing in many countries, as this product is known to be beneficial for infants allergic to bovine milk because it lacks beta-lactoglobulin, being similar to human milk in this respect.

Honey is widely considered as a natural sweetener. It has been claimed that honey has both antibacterial activity and growth-promoting effects, however, the results in the scientific literature are rather controversial.

Previous studies have shown that both cow and camel milks are suitable raw materials for the manufacture of probiotic fermented dairy products and fortification of cultured dairy foods with black locust honey can improve the viability of beneficial bacteria.

The objectives of this work included:

1. Testing the suitability of various culture media for selectively enumerating bifidobacteria and thermophilic and mesophilic lactic acid bacteria species and determining the proper selective conditions.
2. Monitoring the viability during refrigerated storage of *Lactobacillus acidophilus* LA-5 (A), *Bifidobacterium animalis* subsp. *lactis* BB-12 (B), and *Streptococcus thermophilus* CHCC 742/2130 (T) in probiotic cultured dairy foods made from pasteurized camel, cow, goat and sheep milks fermented by an ABT-type culture.
3. Monitoring the survival during refrigerated storage of *Lb. acidophilus* LA-5, *B. animalis* subsp. *lactis* BB-12 and *S. thermophilus* CHCC 742/2130 in cultured dairy foods made from camel and, for comparison, cow milks supplemented with honey at the rate of 5% (w/v) and fermented by an ABT-type culture.
4. Screening five type of honey (black locust, lime, mixed flower, forest and chestnut honey) for inhibitory/stimulatory effects on foodborne pathogenic and beneficial bacteria, yeasts and mold (a total of 27 microorganism strains) by using the agar well diffusion assay.
5. Manufacturing and organoleptically evaluating probiotic foods made from camel and cow milks supplemented with 0% or 5% of black locust honey and fermented by an ABT-type culture.

# 2. MATERIALS AND METHODS

The experiments were carried out in the accredited Food Research and Testing Laboratory of the Hungarian Dairy Research Institute Ltd. and in the accredited Food and Water Testing Microbiological Laboratory of the Institute of Food Science at the Faculty of Agricultural and Food Sciences, University of West Hungary.

## 2.1. Selective enumeration of lactic acid bacteria and bifidobacteria

**Table 1:** List of lactic acid bacteria and bifidobacteria strains used in the first trial

| Species | Strain | Source |
|---|---|---|
| *Bifidobacterium breve* | M-16V | Morinaga Milk Industry |
| *Bifidobacterium animalis* subsp. *lactis* | BB-12 | Chr. Hansen / HDRI Ltd.* |
| *Lactobacillus acidophilus* | LA-5 | |
| *Lactobacillus acidophilus* | NCAIM B.02085 | NCAIM** |
| *Lactobacillus casei* | NCAIM B.01137 | |
| *Lactobacillus casei* | MTKI-R | HDRI Ltd.* |
| *Lactobacillus delbrueckii* subsp. *bulgaricus* | CH-2 | Chr. Hansen / HDRI Ltd.* |
| *Lactobacillus delbrueckii* subsp. *bulgaricus* | YC-X11 | Chr. Hansen / HDRI Ltd.* (FD-DVS YC-X11 strain was isolated from Yo-Flex® yoghurt culture) |
| *Streptococcus thermophilus* | TH-4 | |
| *Streptococcus thermophilus* | DSM 20479 | Deutsche Sammlung von Mikroorganismen und Zellkulturen*** |
| *Lactococcus lactis* subsp. *lactis* biovar. *diacetylactis* | VK-256 | HDRI Ltd.* |

| Species | Strain | Source |
|---|---|---|
| *Lactococcus lactis* subsp. *lactis* | ATCC 19435 | American Type Culture Collection |
| *Leuconostoc mesenteroides* subsp. *dextranicum* | ATCC 19255 | |

* Hungarian Dairy Research Institute Ltd.

** National Collection of Agricultural and Industrial Microorganisms

*** German Collection of Microorganisms and Cell Cultures

**Table 2:** Incubation conditions applied in the medium evaluation study

| Culture medium | Incubation | | |
|---|---|---|---|
| | temperature (°C) | time (h) | conditions |
| CASO agar | According to the demand of the appropriate strain | | |
| MRS pH 5.4 agar | 45 | 48 | Anaerobic |
| MRS pH 5.4 agar | 37 | 72 | Anaerobic |
| MRS pH 6.2 agar | 37 | 72 | Anaerobic |
| M17 agar | 45 | 24 | Aerobic |
| M17 agar | 37 | 48 | Aerobic |
| MRS–CC agar[†] | 37 | 72 | Anaerobic |
| TOS–MUP agar[‡] | 37 | 72 | Anaerobic |

[†] De Man–Rogosa–Sharpe (MRS) agar supplemented with clindamycin and ciprofloxacin.

[‡] Transgalactosylated-Oligosaccharide-agar supplemented with lithium–mupirocin.

One mL of each pure culture (**Table 1**) suspension was tenfold serially diluted ($10^{-6}$ to $10^{-9}$) in 0.1% sterile bacteriological peptone diluent. Enumeration was carried out as specified in **Table 2** using the pour-plate technique. Anaerobic culture jars and AnaeroGen AN 25 sachets were used for creating anaerobic conditions. Plates containing 25 to 250 colonies were evaluated and results were expressed as $\log_{10}$ cfu/mL of culture suspension.

## 2.2. Manufacturing and testing probiotic cultured dairy products made from pasteurized cow, sheep, goat and camel milks fermented by an ABT-type culture

Raw cow, goat, sheep and camel milks were heated to 80 °C and held for 10 min in a water bath. The ABT-5 culture, which consisted of *Lb. acidophilus* LA-5, *B. animalis* ssp. *lactis* BB-12, and *Streptococcus thermophilus* CHCC 742/2130, was purchased from Chr. Hansen in freeze-dried direct vat set form. It was added to the heat-treated process milks cooled to 40°C at the rate of 0,2 g/L. Milks were fermented at 37°C until a pH value of 4.6 was reached. Thereafter, the fermented ABT milks were cooled to 15°C in ice water and were each separated into 21 fractions that were transferred in sterile tightly capped centrifuge tubes (50 mL). After 24 h of cooling at 8°C (d 0), the samples were stored at refrigeration temperature (4°C). The entire experimental program was repeated twice. Three tubes of all 4 products were taken at each sampling time (i.e., following 0, 7, 14, 21, 28, 35, and 42 day of storage). Samples were aseptically removed from centrifuge tubes and diluted by mixing 10 mL with 90 mL of 0.1% peptone water. Further dilutions were made as required. The pour-plate method was used to enumerate microorganisms. M17 agar was used to enumerate *Streptococcus thermophilus* CHCC 742/2130. The inoculated plates were incubated at 45°C for 24 h under aerobic conditions. *Lactobacillus acidophilus* LA-5 was enumerated in de Man, Rogosa, and Sharpe (MRS)-clindamycin-ciprofloxacin agar. The plates were incubated at 37°C for 72 h under anaerobic conditions. Transgalactosylated oligosaccharides-mupirocin lithium salt (TOS-MUP) agar was used for

enumeration of *B. animalis* ssp. *lactis* BB-12. The plates were incubated at 37°C for 72 h under anaerobic conditions. The counts were expressed as $\log_{10}$ cfu/mL

### 2.3. Manufacturing and testing probiotic ABT-type dairy products made from pasteurized camel and cow milks supplemented with black locust honey

Two liters of camel milk and 2 L of cow milk were heated to 90°C and held for 10 min in a water bath, then cooled to 40°C. One half (i.e., 1 L) of both types of milk were fortified with black locust honey at a concentration of 5.0% (w/v), whereas the other half was devoid of honey and served as a control. The camel and cow milks with and without honey were subsequently inoculated with ABT-5 DVS culture at the rate of 0.2 g/L. Milks were fermented at 37°C until a pH value of 4.6 was reached. Thereafter, the fermented ABT milks were cooled to 15°C in ice water and were each separated into 18 fractions that were transferred in sterile, tightly capped centrifuge tubes (50 mL). Thus, a total of 72 units of product were manufactured. After 24 h of cooling at 8°C (d 0), the samples were stored at refrigeration temperature (4°C). Three tubes of all 4 products were taken at each sampling time (i.e., after 0, 7, 14, 21, 28, and 35 d of storage). Samples were aseptically removed from centrifuge tubes and diluted by mixing 10 mL with 90 mL of peptone saline water containing 0.1% casein peptone and 0.85% sodium chloride. Further dilutions were made as required. Microbiological analyses (i.e., enumeration of ABT culture organisms) were carried out as described in subchapter 2.2.

## 2.4. Determining the antimicrobial or stimulatory properties of various types of honey by agar well diffusion assay

The antimicrobial or stimulatory effects of five types of honey (black locust, lime, mixed flower, forest and chestnut honey) on a total of 27 microorganisms, including 17 bacteria, 3 yeast and 7 mold species, were tested using the agar well diffusion assay. The substances screened were honey solutions at 0%, 5%, 10%, 25% and 50% (w/v). The agar plates prepared were incubated in accordance with the specific requirements of the microorganisms tested. After diffusion of the honey solutions into the agar plates three different phenomena could be discovered: inhibitory, stimulatory or neutral effects.

## 2.5. Sensory evaluation of probiotic foods made from camel and cow milks supplemented with honey and fermented by an ABT-type culture

For organoleptic evaluations, probiotic foods were made from pasteurized camel and cow milks supplemented with black locust honey at 5% and fermented by an ABT-type culture. Ranking tests were performed four times within 6 weeks of refrigerated storage by six sensory panelists. The samples were ranked according to the intensity of their sensory properties, with overall taste being the main ranking parameter.

# 3. RESULTS

## 3.1. Selective enumeration of lactic acid bacteria and bifidobacteria

**Table 3:** Suitability of various culture media and incubation conditions for enumerating pure cultures of bifidobacteria and lactic acid bacteria strains*

| Bacterial species and strains | Culture medium, incubation temperature, incubation time, and atmospheric conditions | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **CASO agar**** | **TOS–MUP agar, 37°C, 72 h, anaerobic** | **MRS–CC agar, 37°C, 72 h, anaerobic** | **MRS pH 6.2 agar, 37°C, 72 h, anaerobic** | **MRS pH 5.4 agar, 37°C, 72 h, anaerobic** | **MRS pH 5.4 agar, 45°C, 48 h, anaerobic** | **M17 agar, 37°C, 48 h, aerobic** | **M17 agar, 45°C, 24 h, aerobic** |
| *B. animalis* subsp. *lactis* BB-12 | 8.33 ± 0.18$^{b}$ | 9.30 ± 0.12$^{a}$ | < 6.00 | 8.07 ± 0.14$^{b}$ | < 6.00 | < 6.00 | < 6.00 | < 6.00 |
| *B. breve* M-16V | 8.05 ± 0.11$^{c}$ | 8.76 ± 0.02$^{a}$ | < 6.00 | 8.61 ± 0.04$^{b}$ | < 6.00 | < 6.00 | < 6.00 | < 6.00 |
| *Lb. acidophilus* LA-5 | 8.20 ± 0.05$^{b}$ | < 6.00 | 8.30 ± 0.10$^{ab}$ | 8.34 ± 0.02$^{a}$ | 8.33 ± 0.02$^{a}$ | 8.42 ± 0.11$^{a}$ | 7.84 ± 0.07$^{c}$ | < 6.00 |
| *Lb. acidophilus* NCAIM B.02085 | 8.22 ± 0.06$^{b}$ | < 6.00 | 8.54 ± 0.17$^{a}$ | 8.54 ± 0.04$^{a}$ | 8.54 ± 0.03$^{a}$ | 8.51 ± 0.14$^{a}$ | 8.17 ± 0.09$^{b}$ | < 6.00 |
| *Lb. casei* NCAIM B.01137 | 7.70 ± 0.19$^{a}$ | < 6.00 | 7.30 ± 0.24$^{a}$ | 7.58 ± 0.08$^{a}$ | 7.56 ± 0.08$^{a}$ | < 6.00 | 7.76 ± 0.28$^{a}$ | 7.45 ± 0.17$^{a}$ |
| *Lb. casei* HDRI-R | 7.86 ± 0.15$^{a}$ | < 6.00 | 7.88 ± 0.18$^{a}$ | 7.80 ± 0.17$^{a}$ | 7.64 ± 0.12$^{a}$ | < 6.00 | 7.20 ± 0.15$^{b}$ | 7.30 ± 0.11$^{b}$ |
| *Lb. delbrueckii* subsp. *bulgaricus* YC-X11 | 6.30 ± 0.18$^{b}$ | < 6.00 | < 6.00 | 6.78 ± 0.05$^{a}$ | 6.48 ± 0.09$^{b}$ | < 6.00 | < 6.00 | < 6.00 |
| *Lb. delbrueckii* subsp. *bulgaricus* CH-2 | 6.70 ± 0.18$^{b}$ | < 6.00 | < 6.00 | 7.11 ± 0.09$^{a}$ | 6.30 ± 0.33$^{b}$ | < 6.00 | < 6.00 | < 6.00 |
| *Streptococcus thermophilus* TH-4 | 7.43 ± 0.12$^{a}$ | < 6.00 | < 6.00 | < 6.00 | < 6.00 | < 6.00 | 7.57 ± 0.13$^{a}$ | 6.78 ± 0.18$^{b}$ |
| *Streptococcus thermophilus* DSM 20479 | 8.05 ± 0.22$^{a}$ | < 6.00 | < 6.00 | < 6.00 | < 6.00 | < 6.00 | 7.89 ± 0.17$^{a}$ | 6.90 ± 0.18$^{b}$ |
| *Lactococcus lactis subsp. lactis* ATCC 19435 | 7.98 ± 0.17$^{a}$ | < 6.00 | < 6.00 | 7.81 ± 0.07$^{a}$ | < 6.00 | < 6.00 | 7.71 ± 0.19$^{a}$ | < 6.00 |
| *Lactococcus lactis subsp. lactis biovar. diacetylactis* VK-256 | 7.18 ± 0.12$^{a}$ | < 6.00 | < 6.00 | < 6.00 | < 6.00 | < 6.00 | 6.30 ± 0.27$^{b}$ | < 6.00 |
| *Leuconostoc mesenteroides subsp. dextranicum* ATCC 19255 | 7.80 ± 0.18$^{a}$ | < 6.00 | < 6.00 | < 6.00 | < 6.00 | < 6.00 | < 6.00 | < 6.00 |

* All values are $\log_{10}$ cfu/mL means based on at least two determinations.
[abc] Means within a row without a common superscript differ ($P < 0.05$). ** Incubated at 37°C for 72 h anaerobically (strain #1 to #8), at 37°C for 48 h aerobically (strain #9 and #10), or at 30°C for 72 h under aerobic conditions (strain #11 to #13).

The results of the medium evaluation study are shown in **Table 3**. Milk powder-supplemented CASO agar, which was used as reference medium, supported the growth of all 13 dairy bacteria used. CASO agar incubated at 37°C for 72 h under anaerobic conditions is suitable for the enumeration of the total viable cell counts of *Lactobacillus* spp. and *Bifidobacterium* spp.

Transgalactosylated oligosaccharides-agar supplemented with 50 mg/l mupirocin lithium salt (TOS-MUP agar) incubated at 37°C for 72 h anaerobically was successfully used for the selective enumeration of *B. animalis* subsp. *lactis* BB-12 and *B. breve* M-16V strains in the presence of the following lactic acid bacteria species: *S. thermophilus*, *Lb. delbrueckii* subsp. *bulgaricus*, *Lb. acidophilus*, *Lb. casei*, *Lc. lactis* and *Ln. mesenteroides* subsp. *dextranicum*.

*Lactobacillus acidophilus* could be selectively enumerated in MRS pH 5.4 agar incubated anaerobically at 45°C for 48 h. The recently developed MRS-agar supplemented with 0.1 mg/l clindamycin and 10.0 mg/l ciprofloxacin (MRS-CC agar) was also successfully employed for the same purpose unless *Lb. casei* was present at concentrations similar to or exceeding those of *Lb. acidophilus*.

The viable cell counts of classic yoghurt bacteria, *S. thermophilus* and *Lb. delbrueckii* subsp. *bulgaricus*, could be selectively determined by using M17 agar (37°C, 48 h, aerobiosis) and MRS agars (37°C, 72 h, anaerobiosis), respectively.

### 3.2. Survival of the characteristic microbiota in probiotic fermented camel, cow, goat, and sheep milks during refrigerated storage

Camel, cow, goat, and sheep milks proved to be suitable raw materials for the manufacture of ABT-type fermented dairy products potentially capable of producing a beneficial effect on human metabolism and health even after 6 weeks of refrigerated storage. All the samples tested in this study were found to contain viable cells of probiotic *Lb. acidophilus* LA-5 and *B. animalis* subsp. *lactis* BB-12

at sufficiently high numbers (i.e., $10^6$ to $10^7$ cfu/mL). The cell counts of non-probiotic *S. thermophilus* CHCC 742/2130 also exceeded, by 1 to 2 $\log_{10}$ cycles, the minimum value required by the Codex Alimentarius Hungaricus.

### 3.3. Viability of culture organisms in honey-enriched acidophilus-bifidus-thermophilus (ABT)-type fermented camel milk

Honey addition at the rate of 5% resulted in an increase ($P < 0.05$) in survival rates of *B. animalis* subsp. *lactis* BB-12 in ABT-type fermented camel and cow milks during refrigerated storage up to 5 weeks. Honey fortification of cultured dairy foods is suggested because honey is a healthy natural sweetener with a variety of beneficial microbiological, nutritional, and sensory properties.

### 3.4. Determining the antimicrobial or stimulatory properties of different types of honeys by agar well diffusion

The 25-100% aqueous solutions of black locust, lime, mixed flower, forest and chestnut honeys inhibited the growth of several foodborne pathogenic bacteria, including *Pseudomonas aeruginosa* HNCMB 170001, *Salmonella enterica* subsp. *arizonae* HNCMB 42021 and *Escherichia coli* HNCMB 35035, whereas the same honey types at similar concentrations stimulated the growth of *Lb. acidophilus* ATCC 314, *Lb. casei* ATCC 334 and *S. thermophilus* ATCC 19258. For this reason, fortification of fermented dairy products with honey is suggested because honey increases the microbiological stability of these products.

### 3.5. Sensory evaluation of probiotic foods made from camel and cow milks supplemented with honey and fermented by an ABT-type culture

According to the results of ranking tests done by six sensory panelists, moderately acceptable sensory properties were achieved both in the natural and honey-enriched fermented camel milk products. The application of yogurt culture to ferment camel milk could, however, possibly increase the consumer acceptability of camel milk-based cultured milks, which might be further enhanced by the use of non-sweet flavoring substances.

## 4. NEW SCIENTIFIC FINDINGS

1) CASO agar incubated anaerobically at 37°C for 72 h is suitable for enumerating the total viable cell count of probiotic bacteria (i.e., *Lactobacillus* and *Bifidobacterium* strains) widely used for the production of fermented milks; and MRS pH 5.4 agar incubated under identical conditions is suitable for the selective enumeration of *Lactobacillus* spp.

2) Transgalactosylated oligosaccharides agar supplemented with 50 mg/l of mupirocin lithium salt (TOS-MUP agar) incubated at 37°C for 72 h anaerobically is to be used for the selective enumeration of *Bifidobacterium animalis* subsp. *lactis* BB-12 and *B. breve* M-16V strains in the presence of lactic acid bacteria.

3) *Lactobacillus acidophilus* can be selectively enumerated in MRS pH 5.4 agar incubated anaerobically at 45°C for 48 h. The recently developed MRS-CC agar [i.e., MRS agar supplemented with 0.1 mg/l clindamycin and 10.0 mg/l ciprofloxacin (ISO and IDF, 2006)] can also be successfully employed for the same purpose unless *Lb. casei* was present at concentrations similar to or exceeding those of *Lb. acidophilus*.

4) For selective enumeration of culture organisms in ABT-type fermented milks, use of the following incubation conditions and media are recommended: MRS-CC agar or MRS pH 5.4 agar incubated anaerobically at 37°C for 72 h (*Lb. acidophilus*), TOS-MUP agar incubated in anaerobiosis at 37°C for 72 h (*Bifidobacterium* spp.) and M17 agar incubated under aerobic conditions at 45°C for 24 h (*S. thermophilus*).

5) The presence of black locust honey at 5.0% (w/v) improves ($P < 0.05$) the retention of viability of *B. animalis* subsp. *lactis* BB-12 in ABT-type fermented camel and cow milks during refrigerated storage at 4°C up to 5 weeks. The 25-100% aqueous solutions of black locust, lime, mixed flower, forest and chestnut honeys inhibit the growth of *Pseudomonas aeruginosa* HNCMB 170001, *Salmonella enterica* subsp. *arizonae* HNCMB 42021 and *Escherichia coli* HNCMB 35035, whereas the same honey types at similar concentrations stimulate the growth of *Lb. acidophilus* ATCC 314, *Lb. casei* ATCC 334 and *S. thermophilus* ATCC 19258. Fortification of cultured milks with honey is therefore suggested because honey is capable of increasing the microbiological stability of such products.

## 5. SCIENTIFIC PUBLICATIONS AND PRESENTATIONS ON THE TOPIC OF THE PHD DISSERTATION

### Peer-Reviewed Papers

*In English:*

1. **Süle, J.**, Kőrösi, T., Hucker, A., Varga, L. (2014) Evaluation of culture media for selective enumeration of bifidobacteria and lactic acid bacteria. *Brazilian Journal of Microbiology* 45 (3), 1023–1030. ***[IF: 0.592]***
2. Varga, L., **Süle, J.**, Nagy, P. (2014) *Short communication*: Survival of the characteristic microbiota in probiotic fermented camel, cow, goat, and sheep milks during refrigerated storage. *Journal of Dairy Science* 97 (4), 2039–2044. ***[IF: 2.573]***
3. Varga, L., **Süle, J.**, Nagy, P. (2014) *Short communication*: Viability of culture organisms in honey-enriched acidophilus-bifidus-thermophilus (ABT)-type fermented camel milk. *Journal of Dairy Science* 97 (11), 6814–6818. ***[IF: 2.573]***

*In Hungarian:*

1. **Süle, J.**, Varga, L. (2012) Savanyítással tartósított tejtermékek probiotikus mikrobiótájának vizsgálata az eltarthatóság során. *Konzervújság* 60 (3-4), 63–65.
2. **Süle, J.**, Varga, L. (2009) Méz hatása egy probiotikus savanyú tejtermék mikrobiótájának alakulására. *Tejgazdaság* 69 (1), 17–22.

## Papers Published in Conference Proceedings

*In English:*

1. Varga, L., **Süle, J.**, Szigeti, J. (2012) Stimulation of probiotic lactobacilli and bifidobacteria in cultured dairy foods. *International Scientific Conference on Sustainable Development and Ecological Footprint*. Proceedings. University of West Hungary, Sopron, Hungary, Compact Disc, 5 pp. [ISBN: 978-963-334-047-9]

*In Hungarian:*

1. **Süle, J.**, Kőrösi, T., Takács, G., Hucker, A., Varga, L. (2012) Tejsavbaktériumok és bifidobaktériumok élősejt-számának meghatározására szolgáló tenyésztéses eljárások összehasonlító értékelése. *XXXIV. Óvári Tudományos Nap "A magyar mezőgazdaság – lehetőségek, források, új gondolatok"*. Az előadások és poszterek teljes terjedelemben megjelent anyagai. Nyugat-magyarországi Egyetem, Mezőgazdaság- és Élelmiszer-tudományi Kar, Mosonmagyaróvár, pp. 381–385. [ISBN 978-963-9883-93-2]
2. **Süle, J.**, Tóth, T., Zsédely, E., Varga, L. (2010) A pro- és prebiotikumok szerepe a monogasztrikus és a kérődző állatok takarmányozásában. XXXIII. Óvári Tudományos Nap "*A magyar élelmiszer-gazdaság jövője a KAP reform tükrében*". Az előadások és poszterek teljes terjedelemben megjelent anyagai. Nyugat-magyarországi Egyetem, Mezőgazdaság- és Élelmiszer-tudományi Kar, Mosonmagyaróvár, Compact Disc, 7 pp. [ISBN 978-963-9883-55-0]
3. **Süle, J.**, Varga, L. (2008) Akácméz hatása egy ABT-típusú probiotikus savanyított tej termékazonos mikroorganizmusainak tárolás alatti alakulására. *XXXII. Óvári Tudományos Nap "Élelmiszer-gazdaságunk kérdőjelei napjainkban – Dr. Dr. h. c. Iváncsics János (1938-2002) születésének 70. évfordulója tiszteletére"*. Az előadások és poszterek teljes terjedelemben megjelent anyagai. Nyugat-magyarországi Egyetem, Mezőgazdaság- és Élelmiszer-tudományi Kar, Mosonmagyaróvár, Compact Disc, 4 pp. [ISBN: 978-963-9883-05-5]

## Abstracts

*In English:*

1. **Süle, J.** (2013) Comparative evaluation of conventional plating methods for selective enumeration of viable lactic acid bacteria and bifidobacteria cells. *"Science for Sustainability"*. *International Scientific Conference for PhD students*. Book of Abstracts, Győr, Hungary, p. 359. [ISBN: 978-963-334-103-2]
2. Varga, L., **Süle, J.** (2013) Evaluation of Transgalactosylated oligosaccharides-mupirocin lithium salt agar, MRS-clindamycin-ciprofloxacin agar, and other related culture media for selective enumeration of bifidobacteria and lactic acid bacteria strains. *Gesellschaft für Milchwissenschaft / Society of Milk Science e.V. – Dairy Conference 2013*. Abstracts, Stuttgart-Hohenheim, Germany, p. 94.
3. Varga, L., **Süle, J.** (2011) Use of various bioactive substances to stimulate probiotic bacteria in fermented milks. *International Dairy Federation World Dairy Summit 2011 – Summilk*. Final Programme, Parma, Italy, p. 58.
4. Varga, L., Molnár-Ásványi, N., **Süle, J.** (2011) Development of a novel functional fermented milk containing powdered *Spirulina (Arthrospira) platensis*. *Gesellschaft für Milchwissenschaft / Society of Milk Science e.V. – Milk Conference 2011*. Abstracts, Bern, Switzerland, p. 87.

*In Hungarian:*

1. **Süle, J.** (2009) Mézadagolás hatása egy probiotikus savanyított tejtermék mikroflórájának tárolás alatti alakulására. *XXIX. Országos Tudományos Diákköri Konferencia Agrártudományi Szekció.* Az előadások összefoglalói. Szent István Egyetem, Mezőgazdaság- és Környezettudományi Kar, Gödöllő, p. 160. [ISBN: 978-963-269-095-7]
2. **Süle, J.** (2008) Mézadagolás hatása egy probiotikus savanyított tejtermék mikroflórájának tárolás alatti alakulására. *A MÉTE XVII. Országos Tudományos Diákköri Konferenciája.* Az előadások összefoglalói. Budapesti Műszaki és Gazdaságtudományi Egyetem, Vegyészmérnöki- és Biomérnöki Kar, Budapest, p. 31.