

Institute of Animal Nutrition, Federal Agriculture Research  
Centre (FAL), Braunschweig, Federal Institute  
for Risk Assessment (BfR), Berlin  
and  
Institute of Poultry Diseases,  
Faculty of Veterinary Medicine,  
Free University, Berlin

Detection of Genetically Modified Soybeans and Maize in Egypt as well as Comparative  
Nutritional Safety Investigations of Isogenic and Transgenic (Bt) Maize in Broiler Nutrition:  
Broiler Performance, Degradation and Metabolic Fate of Maize DNA  
in some Tissues and Organs

Thesis submitted  
for the fulfilment of a doctor degree  
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Submitted by  
Mohamed Ahmed Tony Ahmed Marzok  
Veterinarian, B.V.Sc. and M.V.Sc. from Tanta / Egypt

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dem Institut für Geflügelkrankheiten  
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der Freien Universität Berlin

Nachweis von gentechnisch veränderten Sojabohnen und gentechnisch verändertem Mais in  
Ägypten sowie vergleichende Untersuchungen zur ernährungsphysiologischen und  
Sicherheitsbewertung von isogenem und transgenem (Bt) Mais in der Broilerfütterung: Leistung  
der Broiler, Abbau und Verbleib von Mais-DNA in verschiedenen Geweben und Organen

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zur Erlangung des Grades eines  
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vorgelegt von  
Mohamed Ahmed Tony Ahmed Marzok  
Tierarzt, B.V.Sc. und M.V.Sc. aus Tanta / Ägypten

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Dekan : Univ.-Prof. Dr. habil. Leo Brunnberg  
Erster Gutachter : Univ.-Prof. Dr. Dr. habil. Hafez M. Hafez  
Zweiter Gutachter : Univ.-Prof. Dr. Dr. habil. Gerhard Flachowsky  
Dritter Gutachter : Univ.-Prof. Dr. habil. Ortwin Simon

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**It is better to understand a little than  
to misunderstand a lot**

“Anatole France”

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**Abbreviations**

|                  |   |
|------------------|---|
| A                | Adenine   |
| ADF              | Acid detergent fibre  |
| AME <sub>N</sub> | Apparent metabolizable energy (N: corrector factor)   |
| BfR              | Federal institute for Risk Assessment, Berlin, Germany  |
| BgVV             | Federal Institute for Health protection of Consumers and Veterinary Medicine, Berlin, Germany |
| bp               | Base pair (DNA-size)  |
| Bt               | <i>Bacillus thuringensis</i>  |
| BW               | Body weight   |
| C                | Cytosine  |
| Ca               | Calcium   |
| CaMV             | Cauliflower mosaic virus promoter (in GMO constructs)   |
| CDPK             | Calcium dependent protein kinase  |
| CF               | Crude fibre   |
| CP               | Crude protein   |
| CRM              | Certified reference material  |
| CT               | Cycle threshold   |
| CTAB             | Cetyltrimethyl ammonium bromide   |
| d                | Day   |
| dATP             | Deoxyadenosine triphosphate   |
| dCTP             | Deoxycytidine triphosphate  |
| dGTP             | Deoxyguanosine triphosphate   |
| DM               | Dry matter  |
| DNA              | Deoxyribonucleic acid   |
| DNase            | Deoxyribonuclease enzyme  |
| dNTP             | Deoxynucleotide triphosphate  |
| dTTP             | Deoxythymidine triphosphate   |
| E. coli          | Escherichia coli  |
| EDTA             | Ethylene diamine tetraacetic acid   |
| EE               | Ether extract   |
| ELIZA            | Enzyme linked immunosorbent assay   |
| EPSPS            | 5-enolpyruvylshikimate-3-phosphate synthase   |

## *Abbreviations*

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|                   |  |
|-------------------|--|
| ER                | Endoplasmic reticulum                                      |
| f                 | Foreword   |
| FAL               | Federal Agriculture Research Centre, Braunschweig, Germany |
| FCR               | Feed conversion ratio                                      |
| G                 | Guanine  |
| g                 | Gram   |
| GFP               | Green fluorescent protein                                  |
| GIT               | Gastrointestinal tract                                     |
| GM                | Genetically modified                                       |
| GMO               | Genetically modified organism                              |
| GOT               | Glutamic oxalic transaminase                               |
| GPT               | Glutamic pyruvic transaminase                              |
| GTS               | Glyphosate-tolerant soybeans                               |
| $\gamma$ -GT      | Gamma glutamyl transferase                                 |
| h                 | Hour   |
| IgE               | Immunoglobulin E   |
| IU                | International Unit   |
| <i>Ivr</i>        | Maize invertase gene                                       |
| K                 | Potassium  |
| kg                | Kilogram   |
| mA                | Milliampere  |
| ME                | Metabolizable energy                                       |
| mg                | Milligram  |
| MgCl <sub>2</sub> | Magnesium chloride   |
| min               | Minute   |
| ml                | Millilitre   |
| MM                | Maximizer maize  |
| mM                | Micromole  |
| MQDA-PCR          | Multiplex quantitative DNA array based PCR                 |
| mRNA              | Messenger ribonucleic acid                                 |
| NDF               | Neutral detergent fibre                                    |
| NFE               | Nitrogen free extract                                      |
| ng                | Nanogram   |

## *Abbreviations*

---

|                  |   |
|------------------|---|
| nm               | Nanometer                                       |
| OM               | Organic Matter                                  |
| P                | Total phosphorus                                |
| PAT              | Phosphinothricin acetyl-transferase             |
| PCR              | Polymerase chain reaction                       |
| PCV              | Packed cell volume (in whole blood)             |
| pH               | Logarithm of the hydrogen ion concentration     |
| pmol             | Pico mole                                       |
| QC-PCR           | Quantitative competitive PCR                    |
| r                | Reverse   |
| ®                | Registered                                      |
| RH               | Relative humidity                               |
| RNA              | Ribonucleic acid                                |
| RNase            | Ribonuclease enzyme                             |
| RR               | Roundup ready                                   |
| RRS              | Roundup ready soybeans <sup>®</sup>             |
| $\Delta R_n$     | Value of normalized reporter dye fluorescence   |
| s                | Second  |
| SDS              | Sodium dodecyl sulphate                         |
| T                | Thymine   |
| TBE              | Tris-borate-EDTA buffer                         |
| TE               | Tris-EDTA buffer                                |
| ™                | Trademark                                       |
| TME <sub>n</sub> | True metabolizable energy (n: corrector factor) |
| TNE              | Tris-sodium chloride-EDTA buffer                |
| Tris             | Tris(hydroxymethyl)aminomethan                  |
| UV               | Ultraviolet radiation                           |
| v/v              | Volume to volume                                |
| w/v              | Weight to volume                                |
| µg               | Microgram                                       |
| µl               | Microliter                                      |

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## **Curriculum Vitae**

Name (in full underline surname): Mohamed Ahmed Tony Ahmed Marzok

Nationality: Egyptian

Place and date of birth: Tanta / Egypt, 21. August, 1971

Marital status: Single

### **Education:**

- 1976-1982 Preliminary School
- 1982-1985 Intermediate School
- 1985-1988 Secondary School, qualifying for university (Abitur) May, 1988
- 1988-1993 Study (Studium) at Faculty of Veterinary Medicine, Cairo University
- Bachelor of Veterinary Science (*B.V.Sc.*), Faculty of Veterinary Medicine, Cairo University, Approved 31. December, 1993
- Master of Veterinary Science (*M.V.Sc.*), titled: "Effect of Some Essential Fatty Acids and Vitamin E on Performance and Immune Status of Broiler Chickens" Faculty of Veterinary Medicine, Cairo University, September, 1997
- Intensive German language course, Goethe Institute, Cairo, Egypt 1998
- DAAD (Deutscher Akademischer Austausch Dienst) Scholarship 2000
- Intensive German language course (DAAD), Egypt, 2000
- German Language course, Goethe Institute, Göttingen, Germany July, 2000 – September, 2000
- Pass the Rigorous exams (Animal Nutrition, Poultry diseases, Microbiology, Animal Physiology, Animal pathology and Animal hygiene) at the Faculty of Veterinary Medicine, Free University, Berlin, 2003
- International Postgraduate Course, Nutrition and Climate, New Developments, 26 – 29 October 2003 Wageningen, The Netherlands.

### **Professional Occupation**

- Demonstrator of Animal Nutrition and Clinical Nutrition, Faculty of Veterinary Medicine, Cairo University 1994 – 1997



- Assistant Lecturer of Animal Nutrition and Clinical Nutrition, Faculty of Veterinary Medicine, Cairo University September, 1997 – the present time
- Teaching Assist at the Department of Animal Nutrition and Clinical Nutrition, Faculty of Veterinary Medicine, Cairo University
- Doctor candidate at Animal Nutrition Institute, Federal Agricultural Research Centre (FAL), Braunschweig and Federal Institute for Risk Assessment (BfR), Berlin since October, 2000

**Permanent Address:**

Department of Animal Nutrition and Clinical Nutrition  
Faculty of Veterinary Medicine  
Cairo University,  
12211 Giza, Egypt

Tel.: +2 02 8111990 / +2 040 3513856

Fax: +2 02 5725240

E-mail: mohamed\_tony@hotmail.com

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### **Selbständigkeitserklärung**

Hiermit erkläre ich Mohamed Ahmed Tony, dass die vorliegende Arbeit von mir persönlich und nur unter zu Hilfenahme der im Inhaltsverzeichnis aufgeführten Hilfsmittel erstellt wurde.

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