

## Contents

Abstract .....	ii
Figures.....	v
Tables .....	v
Graphs .....	vi
Abbreviations .....	vii
1 Introduction .....	1
2 Quality management .....	3
2.1 Definitions.....	4
2.2 Prerequisite programs .....	5
2.2.1 Good Agricultural Practices.....	6
2.2.2 Good Hygiene Practices.....	6
2.3 HACCP system .....	8
2.3.1 HACCP critical appraisal.....	9
2.3.2 Existing evidence of beekeepers' compliance with the HACCP system..	11
2.4 Summary .....	12
3 Honey; contaminants and hazard analysis .....	13
3.1 Honey contaminants.....	13
3.1.1 Beekeeping practices.....	13
3.1.2 Environmental contaminants.....	14
3.1.3 Secondary contamination.....	15
3.2 Honey hazards analysis .....	15
3.2.1 Honey flow diagram.....	15
3.2.2 Honey hazards.....	16
3.2.3 Control measures.....	16
4 Brazilian honey sector.....	18
4.1 Honey chain .....	18
4.2 Brazilian legislation .....	20
4.3 Production .....	21
4.4 Trade .....	24
5 Honey sector in the State of Ceará/Brazil.....	25
5.1 Socioeconomic conditions .....	25
5.2 Production aspects.....	26
5.3 Credit opportunities.....	27

5.4 Technical assistance .....	28
5.5 Beekeepers organizations .....	28
6 Conceptual framework .....	28
6.1 The diffusion of innovation process.....	30
7 Methodology .....	36
7.1 Survey data.....	36
7.2 Identification of the population .....	37
7.3 Sampling procedure .....	39
7.4 Empirical analysis .....	41
8 Results.....	43
8.1 Infrastructure for honey extraction.....	44
8.2 HACCP-based quality management .....	46
8.3 Factors influencing beekeepers' knowledge .....	47
8.4 Multivariate regression model: Knowledge .....	51
8.5 Outcome from beekeepers' knowledge.....	52
8.6 Factors influencing the implementation.....	54
8.7 Multivariate regression model: Implementation .....	61
8.8 Outcome from beekeepers' implementation .....	64
8.9 Conclusions from the results.....	66
8.10 Results' limitations .....	68
9 Implications.....	69
9.1 Implications for the beekeepers .....	69
9.2 Implications for exporting firms .....	71
9.3 Implications for policy makers .....	71
9.4 Implications for further research.....	73
10 Discussion and conclusions .....	74
11 References .....	78
12 Annexes.....	83
12.1 Annex1: Principles of HACCP system .....	83
12.2 Annex 2: Questionnaire .....	84

## **Figures**

Figure 1: Food quality management .....	12
Figure 2: Honey production and honey extraction flow diagram. ....	16
Figure 3: Brazilian honey chain.....	19
Figure 4: Appropriate house for honey extraction.....	21
Figure 5: Brazilian honey destination .....	25
Figure 6: Conceptual framework .....	35
Figure 7: Research location .....	38
Figure 8: Common and adapted houses.....	44
Figure 9: Constructed houses.....	45
Figure 10: Conditions of honey extraction .....	46
Figure 11: Framework of the empirical analysis .....	68

## **Tables**

Table 1: World honey production in 1999 and in 2008 .....	23
Table 2: Questionnaire contents.....	36
Table 3: Sampling framework .....	41
Table 4: HACCP-based quality management .....	46
Table 5: Beekeepers' characteristics.....	48
Table 6: Technical assistance (a) .....	48
Table 7: Technical assistance (b).....	49
Table 8: Integration into the value chain (a).....	49
Table 9: Membership of associations (a).....	50
Table 10: Place of residence (a).....	50
Table 11: Distance to the city (a).....	51
Table 12: Multivariate regression model: knowledge.....	52
Table 13: Farm performances .....	53
Table 14: Condition of the house of extraction (a) .....	53

Table 15: Knowledge .....	54
Table 16: Technical assistance (c) .....	54
Table 17: Technical assistance (d) .....	55
Table 18: Integration into the value chain (b).....	55
Table 19: Membership of organizations (b).....	56
Table 20: Place of residence (b).....	56
Table 21: Distance to the city (b).....	56
Table 22: Condition of the house of extraction (b).....	57
Table 23: Distance between beehives and extraction house .....	57
Table 24: Farm size.....	58
Table 25: Beekeepers wealth (BR\$) .....	58
Table 26: Access to credit.....	59
Table 27: Household characteristics .....	59
Table 28: Family labor.....	60
Table 29: Hired labor .....	60
Table 30: Multivariate regression model 1: Implementation .....	62
Table 31: Multivariate regression model 2: Implementation .....	63
Table 32: Honey production costs (BR\$) .....	66
Table 33: Honey rent (BR\$) .....	65
Table 34: Importance of the honey rent for the family .....	65
Table 35: Condition of the house of extraction (b).....	66

## **Graphs**

Graph 1: Evolution of the Brazilian honey production.....	22
Graph 2: Honey production per states in tonnes.....	23
Graph 3: Brazilian exportation rates in the last decade.....	24
Graph 4: HACCP-based quality management .....	47

## **Abbreviations**

BR\$	Brazilian Reais
CAC	Codex Alimentarius Commission
CCP	Critical Control Points
EC	European Commission
EMATERCE	Empresa de Assistência Técnica e Extensão Rural do Ceará
EU	European Union
FAO	Food Agriculture Organization
FECAP	Federação dos Apicultores
GAP	Good Agricultural Practices
GDP	Good Distribution Practices
GHP	Good Hygiene Practices
GMP	Good Manufacturing Practices
HACCP	Hazard Analysis and Critical Control Point
HMF	Hydroxy-methyl-furfural
IBD	Instituto Biocinâmico
MAPA	Ministério da Agricultura Pecuária e Abastecimento
MRLs	Maximum Residue Limits
PRONAF	Programa Nacional para a Agricultura Familiar
SEBRAE	Serviço Brasileiro de Apoio às Micro e Pequenas Empresas
SENAR	Serviço Nacional de Aprendizagem Rural
SIF	Serviço de Inspeção Federal
US	United States of America
WHO	World Health Organization