# Contents

**1. Introduction 1**

**2. Review of literature 4**

2.1. General properties and characteristics of antinutritional factors in legumes 4

2.1.1. Tannins 4

2.1.2. Phytic acid 5

2.1.3. Trypsin inhibitors 6

2.1.4. Haemagglutinins 6

2.1.5. Biogenic amines 6

2.1.6. Oligosaccharides 7

2.2. Dietary intake and biochemical effects of antinutritional factors on human health 7

2.3. Strategies for reduction of antinutritional factors 9

2.3.1. Physical processing 9

2.3.1.1. Dehulling 9

2.3.1.2. Soaking 9

2.3.1.3. Cooking 10

2.3.2. Bio-processing 10

2.3.2.1. Germination 10

2.3.2.2. Fermentation 11

2.3.2.3. Enzymic processing 11

2.4. Some common legume-based fermented foods of India 12
2.4.1. Kinema 13
2.4.2. Idli 13
2.4.3. Dhokla 14
2.5. Safety aspects 15

**3. Materials and methods 16**
3.1. Materials 16
3.1.1. Culture media 16
3.1.2. Chemicals 16
3.1.3. Reagents 17
3.2. Experimental 18
3.2.1. Preparation of samples 18
3.2.2. Extraction and estimation of antinutritional factors 18
3.2.2.1. Tannins 18
3.2.2.2. Phytic acid 18
3.2.2.3. Trypsin inhibitor activity 19
3.2.2.4. Haemagglutinating activity 19
3.2.2.5. Total biogenic amines 19
3.2.2.6. Oligosaccharides 20
3.2.3. Microbiological analysis 20
3.2.3.1. Total aerobic mesophilic bacteria 20
3.2.3.2. Lactic acid bacteria 20
3.2.3.3. Yeasts 20
3.2.4. Physicochemical analysis 20
3.2.4.1. pH 21
3.2.4.2. Titratable acidity 21
3.2.5. Sensory analysis 21
3.2.6. Minimization of antinutrients using response surface optimization of processing parameters 21
3.2.6.1. Experimental design 21
3.2.6.2. Fermented foods 23
3.2.6.2.1. Kinema 23
3.2.6.2.1.1. Soaking 23
3.2.6.2.1.2. Cooking 23
3.2.6.2.1.3. Fermentation 25
3.2.6.2.2. Idli 26
3.2.6.2.2.1. Soaking 26
3.2.6.2.2.2. Mixing of batters 28
3.2.6.2.2.3. Fermentation 28
3.2.6.2.2.4. Steaming 30
3.2.6.2.3. Dhokla 30
3.2.6.2.3.1. Soaking 30
3.2.6.2.3.2. Mixing of batters 33
3.2.6.2.3.3. Fermentation 33
3.2.6.2.3.4. Steaming 33
3.2.7. Statistical analysis 33

**4. Results 35**
4.1. Kinema 35
4.1.1. Raw beans 35

4.1.2. Soaking 35
4.1.3. Cooking 38
4.1.4. Fermentation 40
4.2. Idli 42
4.2.1. Raw ingredients 42
4.2.2. Soaking 43
4.2.3. Unfermented mixed batters 50
4.2.4. Fermentation 50
4.2.5. Steaming 52
4.2.6. Microbiological study 53
4.3. Dhokla 54
4.3.1. Raw ingredients 54
4.3.2. Soaking 55
4.3.3. Unfermented mixed batters 58
4.3.4. Fermentation 58
4.3.5. Steaming 60

**5. Discussion 62**
5.1. Raw ingredients 62
5.2. Soaking 62
5.3. Cooking of soybeans 64
5.4. Unfermented mixed batter 65
5.5. Fermentation 65
5.6. Microbiological analysis 66
5.7. Steaming of fermented products 67

**6. Bibliography 68**

**Subject index 77**