

CONTENTS

	Page
ACKNOWLEDGEMENTS	iii
ABSTRACT	iv
LIST OF TABLES	xiii
LIST OF FIGURES	xvi
PART I.	1
INTRODUCTION	1
1. Botanical characteristics of the family Solanaceae.	2
2. Botanical characteristics of the genus <u>Datura</u> .	4
2.1 Section I. <u>Stramonium</u> [Tournefort] Bernhardt.	5
2.1.1 <u>D. stramonium</u> L. (<u>D. tatula</u> L., <u>D. inermis</u> Jacq.).	6
2.1.2 <u>D. ferox</u> L. (<u>Stramonium ferox</u> Baccone).	6
2.1.3 <u>D. quercifolia</u> H.B.K.	7
2.2 Section II. <u>Dutra</u> Bernhardt.	7
2.2.1 <u>D. pruinosa</u> Greenm.	7
2.2.2 <u>D. leichhardtii</u> Muell.	8
2.2.3 <u>D. meteloides</u> DC. in Dunal.	8
2.2.4 <u>D. metel</u> L. (<u>D. fastuosa</u> L., <u>D. alba</u> Nees.)	8
2.2.5 <u>D. innoxia</u> Mill.	9
2.2.6 <u>D. discolor</u> Bernh.	10
2.3 Section III. <u>Ceratocaulis</u> (Spach.) Bernhardt.	10
2.3.1 <u>D. Ceratocaulis</u> Ort.	10
2.4 Section IV. <u>Brugmansia</u> (Persoon) Bernhardt.	10

	Page
3. Botanical characteristics of <u>Datura metel</u> var. <u>fastuosa</u>	11
4. Chemistry of tropane alkaloids in genus <u>Datura</u> .	12
4.1 Chemistry of tropane alkaloids.	19
4.2 Tropane alkaloids of <u>Datura metel</u> L. var. <u>fastuosa</u> Safford	19
5. Biosynthesis of tropane alkaloids.	21
5.1 Biosynthesis of hyoscyamine (atropine).	21
5.2 Biosynthesis of hyoscyne.	25
6. Extraction and isolation of tropane alkaloids.	25
7. Quantitative determination of tropane alkaloids.	28
8. Medicinal properties and uses.	33
9. Objectives.	35
PART II.	36
EXPERIMENTAL.	36
1. Equipments and chemicals.	36
2. Methods.	38
2.1 Experimental site.	38
2.2 Growing and management.	38
2.3 Evaluation of the products.	43
2.3.1 Preparation of the samples for analysts.	43
2.3.2 Quantitative determination of total alkaloids using titrimetric method.	45
2.3.3 Quantitative determination of atropine and hyoscyne using GLC method.	47

	Page
2.3.3.1 Calibration graphs of atropine and hyoscine.	47
2.3.3.2 Determination of samples	49
2.3.3.3 Estimation of atropine and hyoscine recovery from the method used.	50
PART III.	52
RESULTS AND DISCUSSION.	52
1. Effects of fertilizers and stages of development on plant growth.	52
2. Effects of fertilizers and stages of development on dry matter production.	61
3. Effects of fertilizers and stages of development on alkaloid contents.	63
3.1 Quantitative determination of total alkaloids.	64
3.2 Quantitative determination of atropine and hyoscine.	66
3.2.1 Recovery of added atropine and hyoscine from the method used.	75
3.2.2 Determination of precision of the assay methods of atropine, hyoscine and total alkaloids.	75

	Page
3.3 Statistical evaluation of total alkaloid, hyoscyamine (atropine) and hyoscine contents at different stages of development and as affected by fertilizers.	77
3.4 Influence of fertilizers and development stages on alkaloid contents in different of plant.	80
3.4.1 Influence of fertilizers on alkaloid contents in different parts of plant.	80
3.4.2 Influence of development stages on alkaloid contents in different parts of plant.	82
PART IV.	88
CONCLUSION.	88
REFERENCES.	90
APPENDIX.	106
(A) Quantitative determination of total alkaloids.	107
(B) Column preparation.	112
(C) Quantitative determination of atropine and hyoscine.	114
(D) Methods of statistical analysis.	119
(i) Evaluation of fertilizers and stages of development effects on dry matter production.	119
(ii) Evaluation of the known extraction and purification procedure.	122

	Page
(iii) Determination of the least squares regression line of atropine.	123
(iv) Determination of the least squares regression line of hyoscine.	127
(v) Calculation of precision for assay methods.	129
(vi) Evaluation of total alkaloid, hyoscyamine (atropine) and hyoscine contents at different stages of development and as affected by fertilizers.	130
BIOGRAPHY.	136

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

Copyright© by Chiang Mai University

All rights reserved

LIST OF TABLES

TABLE		Page
1	Alkaloid contents of <u>Datura</u> species.	13
2	Alkaloids of <u>Datura</u> species.	17
3	Percentage of alkaloids in <u>D. metel</u> var. <u>fastuosa</u> (calculated on dry weight basis)	22
4	Summarization of tropane alkaloids determination by GLC.	31
5	Environmental conditions during the experimental period.	39
6	Data on soil properties before the fertilizer application.	40
7	Planting and harvesting date of <u>D. metel</u> var. <u>fastuosa</u>	44
8	Height during the growth of <u>D. metel</u> var. <u>fastuosa</u> as affected by fertilizer treatments.	53
9	Dry matter (g/plot) of important plant parts as affected by fertilizers and development stages.	62
10	Comparisons of total alkaloid, atropine and hyoscyne contents by titrimetric and gas liquid chromatographic methods in the same sample code.	67
11	Relation of intercept and slope of calibration graph obtained by the method of least squares.	75
12	Recovery of added atropine and hyoscyne (in the flowering samples).	76
13	Determination of precision of the assay methods from sample L-S ₂ B ₂ F ₁ .	78

	Page
14 Percentages of total alkaloids, hyoscyamine (atropine) and hyoscyne in various parts of <u>D. metel</u> var. <u>fastuosa</u> at different stages of development.	85
15 Total alkaloid contents in different parts at various stages of <u>D. metel</u> var. <u>fastuosa</u> .	107
16 Comparisons of the yields of atropine and hyoscyne from different parts at various stages of <u>D. metel</u> var. <u>fastuosa</u> .	114
17 Dry weight per plot of leaves, flowers and seeds at different stages of <u>D. metel</u> var. <u>fastuosa</u> as affected by fertilizer applications.	120
18 Analysis of variance for the data shown in table 17 to compare dry matter production from fertilizers and stages of development effects.	121
19 Total alkaloid percentages in <u>D. metel</u> var. <u>fastuosa</u> leaves from various methods.	123
20 Analysis of variance for the data shown in Table 19 to compare the results of various methods.	124
21 The differences of the treatment means.	125
22 Raw data from the Figure 16 for calculating the least squares line.	126
23 Raw data from the Figure 17 for calculating the least squares line.	128
24 Analysis of variance table for total alkaloids (in leaves).	131

	Page
25 Analysis of variance table for hyoscyamine (atropine) (in leaves).	131
26 Analysis of variance table for hyoscine (in leaves).	132
27 Analysis of variance table for total alkaloids (in flowers).	133
28 Analysis of variance table for hyoscyamine (atropine) (in flowers).	133
29 Analysis of variance table for hyoscine (in flowers).	134

LIST OF FIGURES

FIGURE		Page
1	Structural formulas of tropane (I), tropic acid (II), tropanol (III), scopolin (IV), hyoscyamine (V) and hyoscyamine.	20
2	Biosynthesis of hyoscyamine.	24
3	Biosynthesis of hyoscyamine.	26
4	A diagram showing the planning of experimental plots for <u>D. metel</u> var. <u>fastuosa</u> .	42
5	Height increasing of <u>D. metel</u> var. <u>fastuosa</u> as affected by fertilizer treatments.	54
6	Whole plant of the cultivated <u>D. metel</u> var. <u>fastuosa</u> .	55
7	Leaves of <u>D. metel</u> var. <u>fastuosa</u> .	56
8	Preflowering (or bud initiation) of <u>D. metel</u> var. <u>fastuosa</u> .	57
9	Flowers of <u>D. metel</u> var. <u>fastuosa</u> .	58
10	Fruit setting of <u>D. metel</u> var. <u>fastuosa</u> .	59
11	Fruit dehiscence of <u>D. metel</u> var. <u>fastuosa</u> .	59
12	Fruit and seeds of <u>D. metel</u> var. <u>fastuosa</u> .	60
13	The GLC analysis of the crude extract from <u>D. metel</u> var. <u>fastuosa</u> when 6 ft. column was used : 1. homatropine (internal standard) ; 2. atropine ; 3. hyoscyamine.	69

	Page
14 The GLC analysis of the crude extract from <u>D. metel</u> var. <u>fastuosa</u> . when 12 ft. column was used: 1. homatropine (internal standard) ; 2. atropine ; 3. hyoscine.	70
15 The GLC analysis of the crude extract from <u>D. metel</u> var. <u>fastuosa</u> . when 12 ft. column was used: 1. methyl linoleate (internal standard) ; 2. atropine; 3. hyoscine.	72
16 Calibration graph of atropine by GLC method.	73
17 Calibration graph of hyoscine by GLC method.	74
18 Comparisons of total alkaloid, hyoscyamine (atropine) and hyoscine contents in various parts at different stages of development.	81

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

Copyright© by Chiang Mai University

All rights reserved