Why are some plants poisonous ?

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A. Herbivory

Why are some plants poisonous ?

A. Herbivory

B. How do plants protect themselves against herbivory?

1. Physical Protection

   (spines, thorns, leaf hairs)

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   (spines, thorns, leaf hairs)

2. Chemical protection that affects taste, smell or other physiological damage.

Poison – any substance, particularly chemical, that causes injury, illness or death.

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"*All substances are poisonous; there is none which is not a poison. The right dose differentiates a poison and a remedy*"

Paracelsus (1493 – 1541)

Toxicant

Xenobiotic

Natural toxin

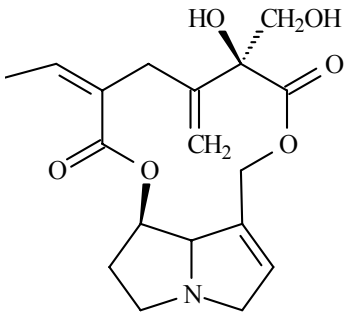
Phytotoxin

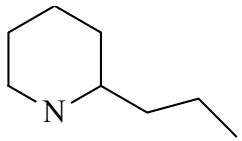
Mycotocin

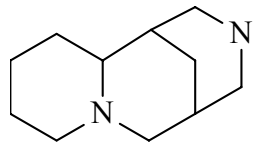
Classes of Toxins

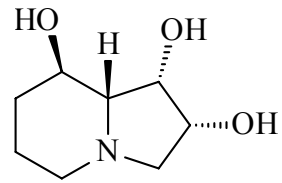
Classes of Toxins

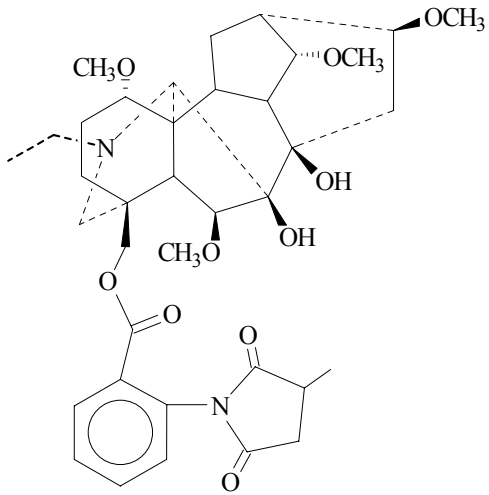
Alkaloids

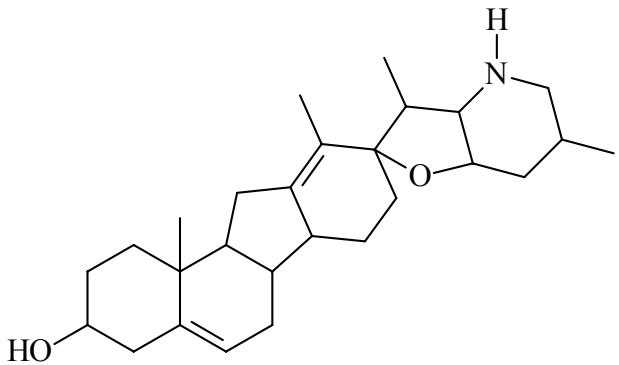




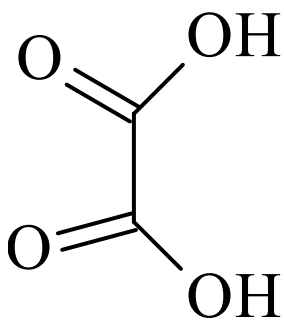






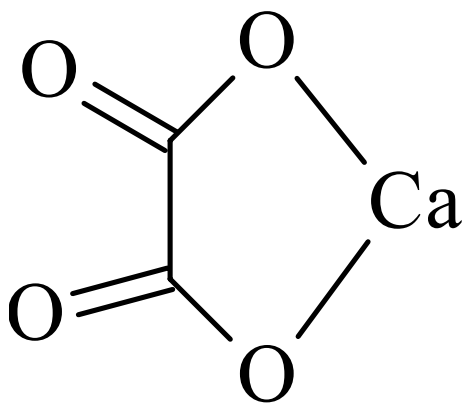


Metal-binding Compounds

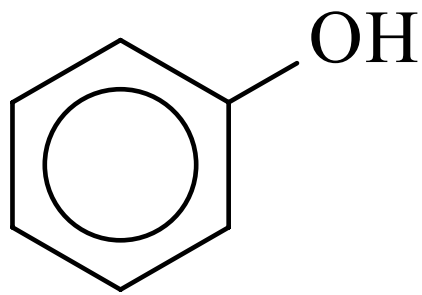


Ca^{2+}

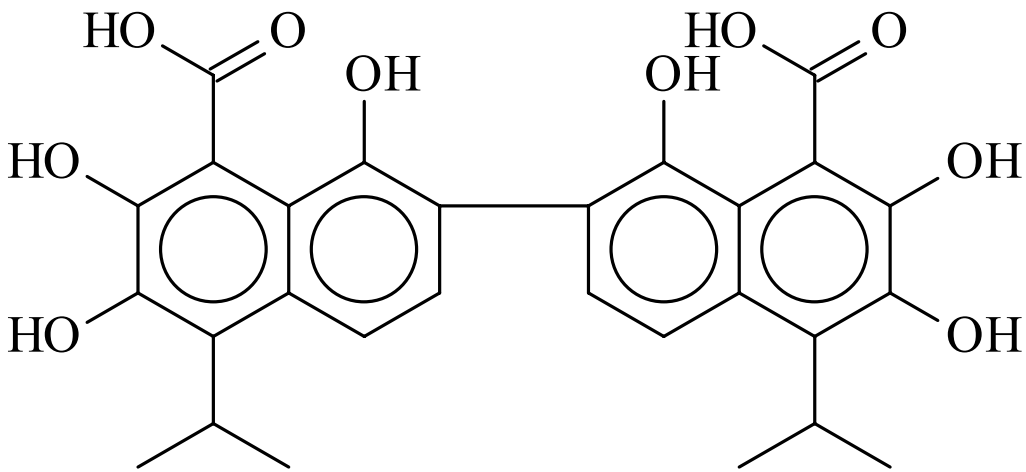
Metal-binding Compounds



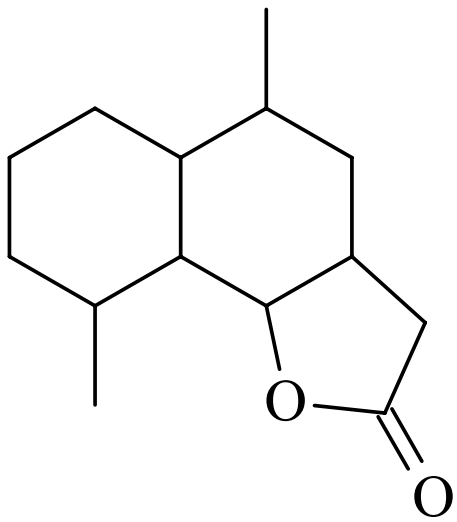
Phenolic compounds



Phenolic compounds



Sesquiterpene Lactones



B. Physiological Effects

hepatotoxins

neurotoxins

myotoxins

Identification of Plant Toxins

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A. Need an appropriate biological assay for testing toxicity.

Identification of Plant Toxins

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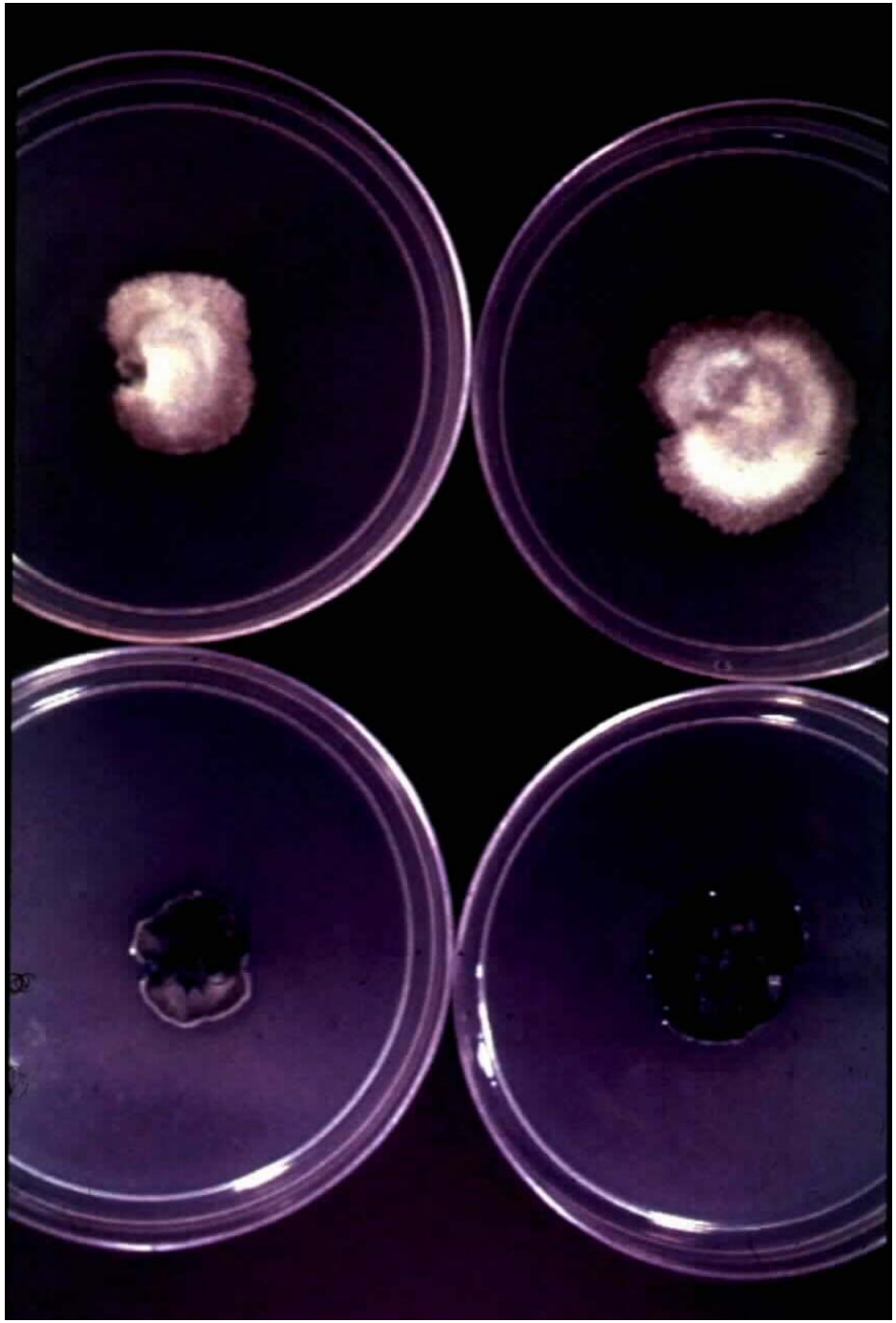
    1. Cell, enzyme, chemical based assay.



Identification of Plant Toxins

A. Need an appropriate biological assay for testing toxicity.

   1. Cell, enzyme, chemical based assay.

   2. Small Animal Assay (mouse, rat).

Identification of Plant Toxins

A. Need an appropriate biological assay for testing toxicity.

   1. Cell, enzyme, chemical based assay.

   2. Small Animal Assay (mouse, rat).

   3. Large Animal Assay (sheep, cow).

B. Bioassay guided chemical fractionation.

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1. Chemical Extraction of Plant material.


LAMMABLE

B. Bioassay guided chemical fractionation.

1. Chemical Extraction of Plant material.
2. Test extracts or residue with appropriate bioassay.


BE
CAREFUL
A CAREFUL WORKMAN
IS THE BEST
SAFETY DEVICE

Feeding Trials with Pine Needles, Residues and Extracts

Test Material	# Abortions/ # Test Animals
Pine Needles	7/7
Residue	
Water	3/3
Ethanol	2/6
Acetone	0/1
MeCl	0/4
Hexane	1/2
MeCl Extract	4/4

B. Bioassay guided chemical fractionation.

1. Chemical Extraction of Plant material.
2. Test extracts or residue with appropriate bioassay.
3. Continue fractionation of positive materials.

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1. Chemical Extraction of Plant material.
2. Test extracts or residue with appropriate bioassay.
3. Continue fractionation of positive materials.
4. Assay new fractions.


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B. Bioassay guided chemical fractionation.

1. Chemical Extraction of Plant material.
2. Test extracts or residue with appropriate bioassay.
3. Continue fractionation of positive materials.
4. Assay new fractions.
5. Identification of chemical components in active fractions.

Pine Needle Acid Fraction [J]

GC chromatogram of Methyl Esters

1) isopimaric

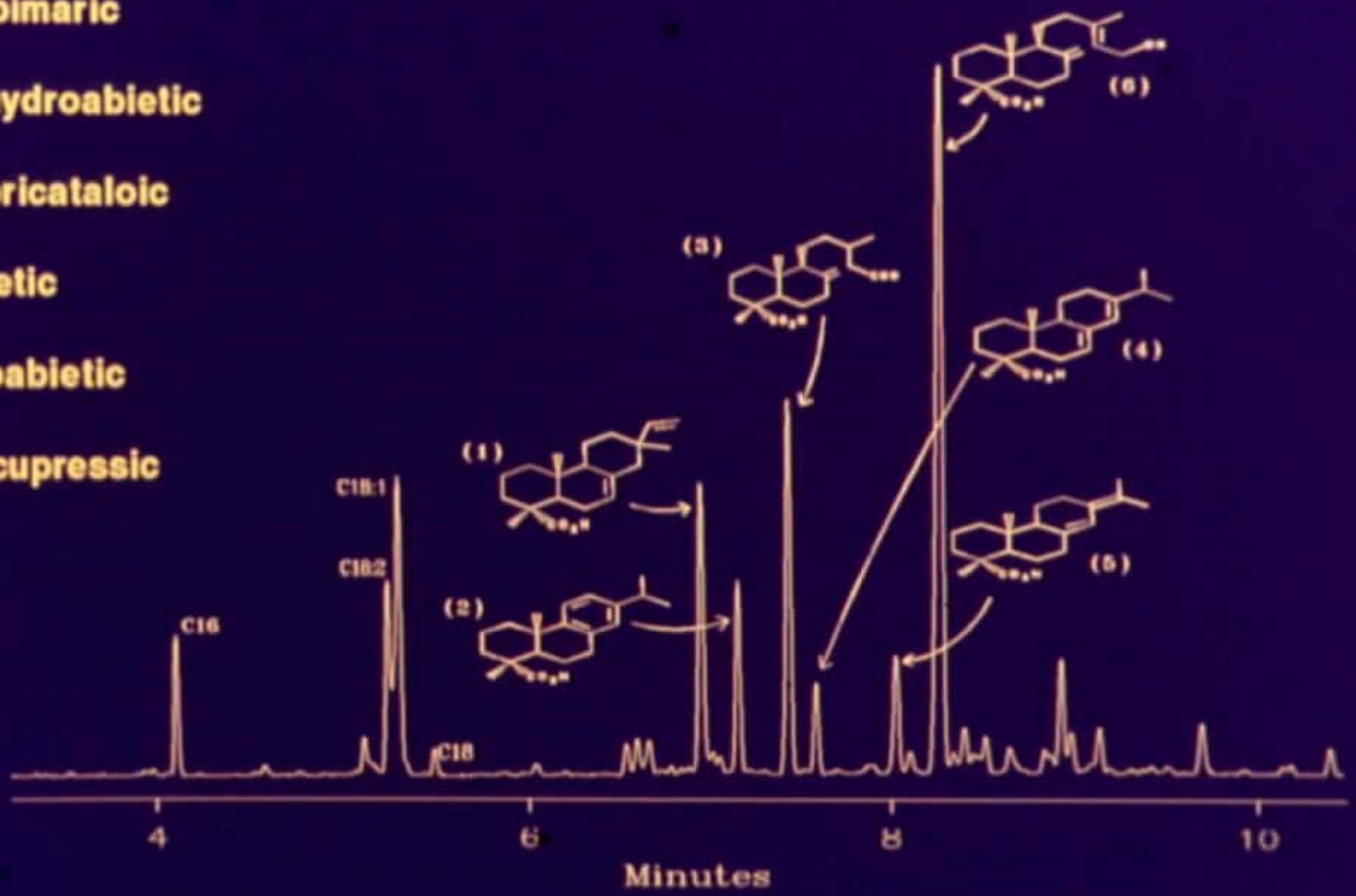
2) dehydroabietic

3) imbricataloic

4) abietic

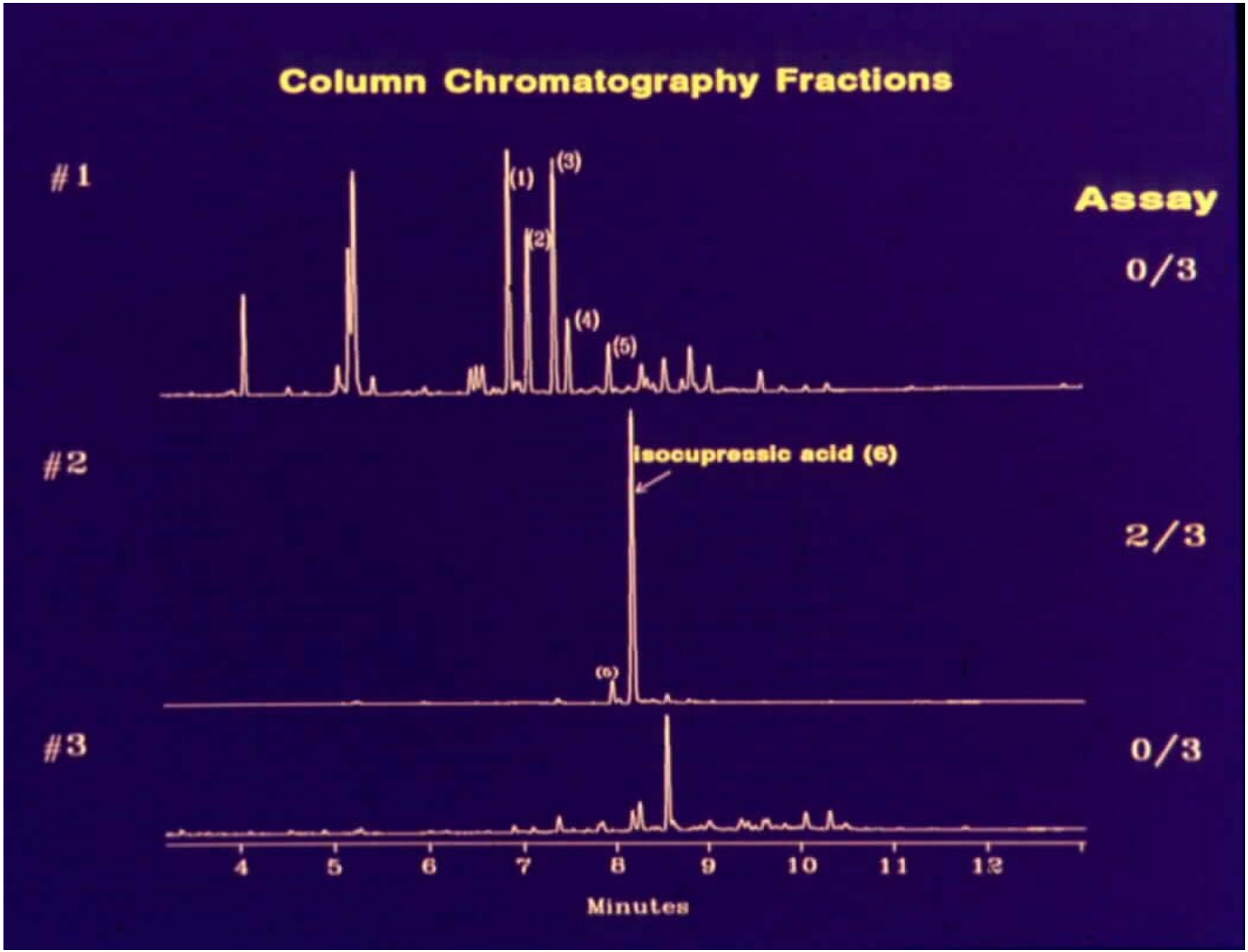
5) neoabietic

6) isocupressic



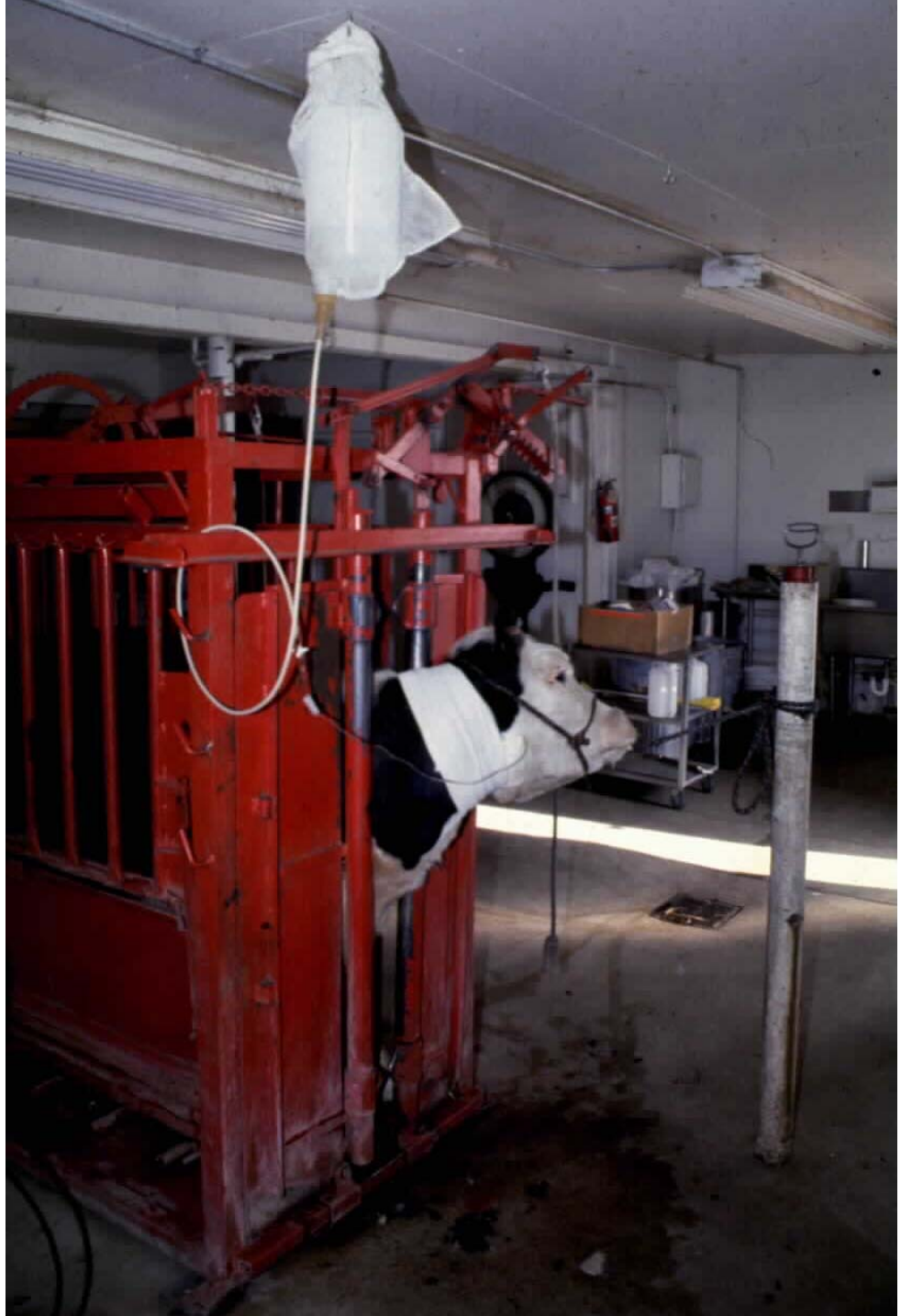
B. Bioassay guided chemical fractionation.

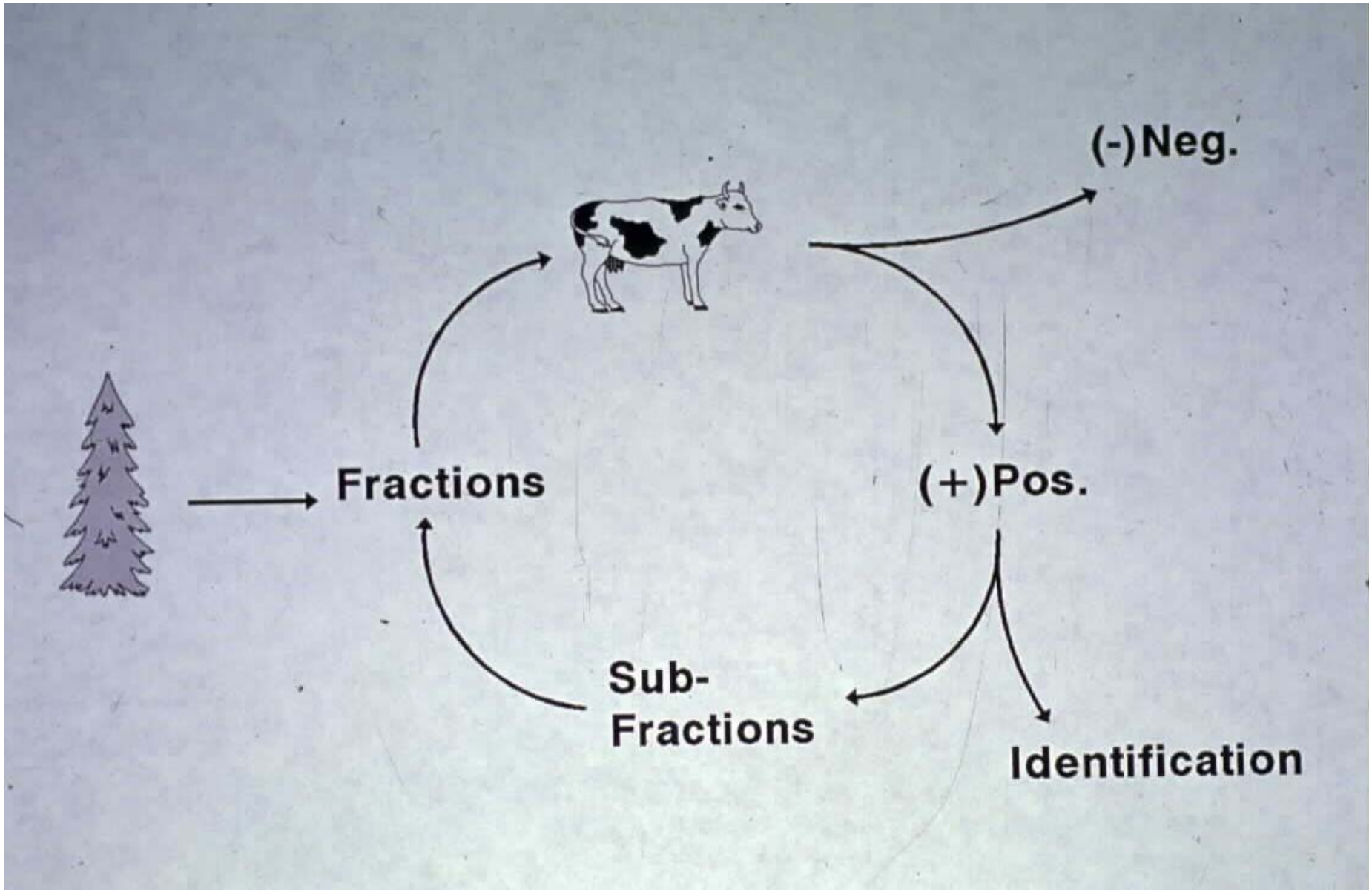
1. Chemical Extraction of Plant material.
2. Test extracts or residue with appropriate bioassay.
3. Continue fractionation of positive materials.
4. Assay new fractions.
5. Identification of chemical components in active fractions.
6. Assay of individual components.


Column Chromatography Fractions
#1
(1)
(2)
(3)
(4)
(5)
Assay
0/3
#2
Isocupressic acid (6)
(6)
2/3
#3
0/3
4
5
6
7
8
9
10
11
12
Minutes

B. Bioassay guided chemical fractionation.

1. Chemical Extraction of Plant material.
2. Test extracts or residue with appropriate bioassay.
3. Continue fractionation of positive materials.
4. Assay new fractions.
5. Identification of chemical components in active fractions.
6. Assay of individual components.
7. Confirmation of toxic compound in large animal.




(-)Neg.
Fractions
(+)Pos.
Sub-
Fractions
Identification

Analysis of Plant Toxins

Analysis of Plant Toxins

A. Plant Toxicity and Toxic Dose.

Analysis of Plant Toxins

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1. Concentration of toxin in the plant can be measured.

   % dry weight, mg/g, ppm, ppb

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A. Plant Toxicity and Toxic Dose.

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2. Toxic dose = mg toxin/kg body weight

   LD50 = 4.5 mg/kg

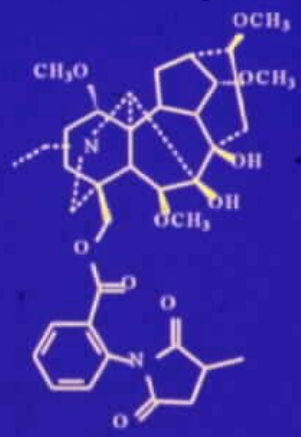
Analysis of Plant Toxins

A. Plant Toxicity and Toxic Dose.

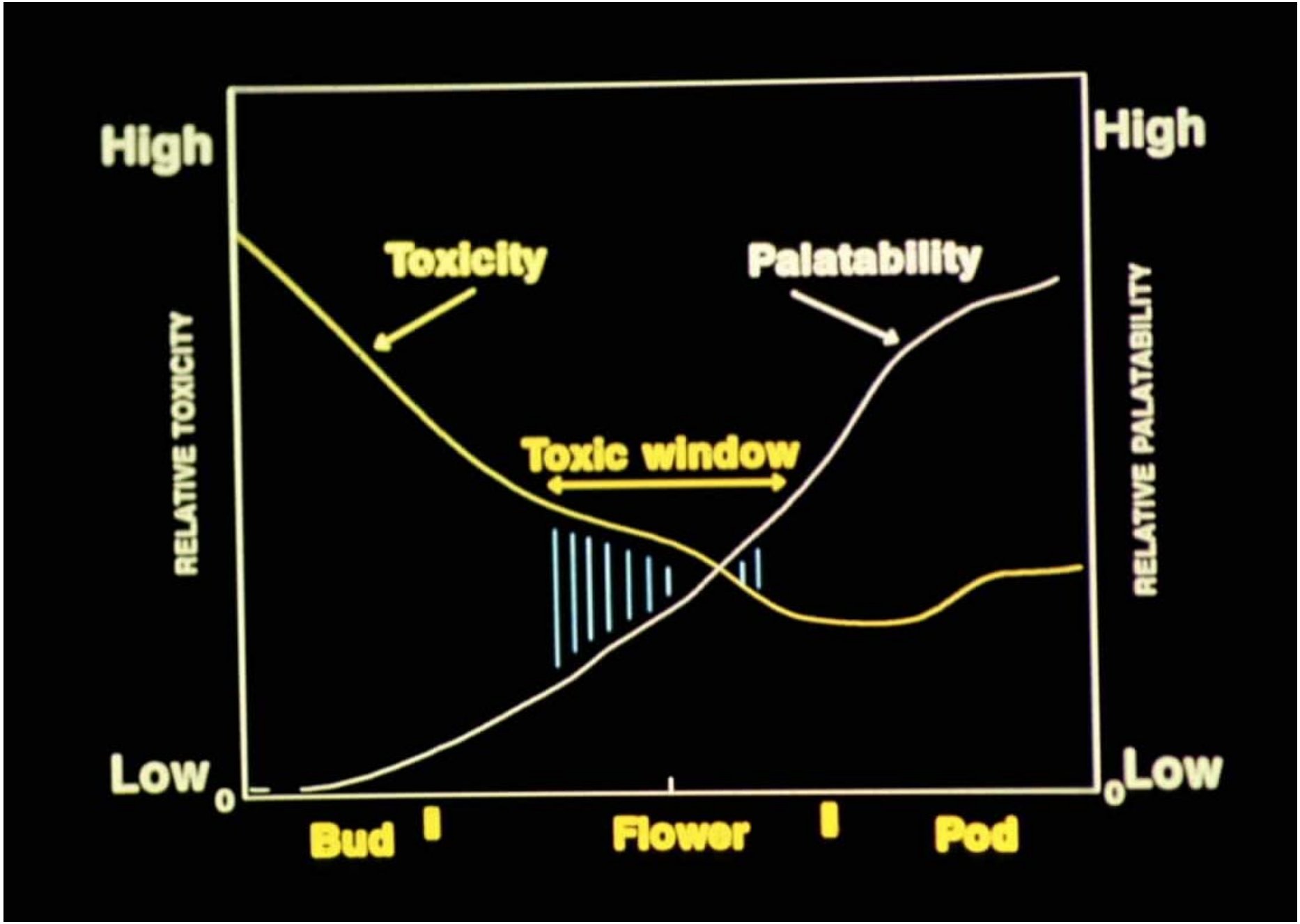
1. Concentration of toxin in the plant can be measured.

2. Toxic dose = mg toxin/kg body weight

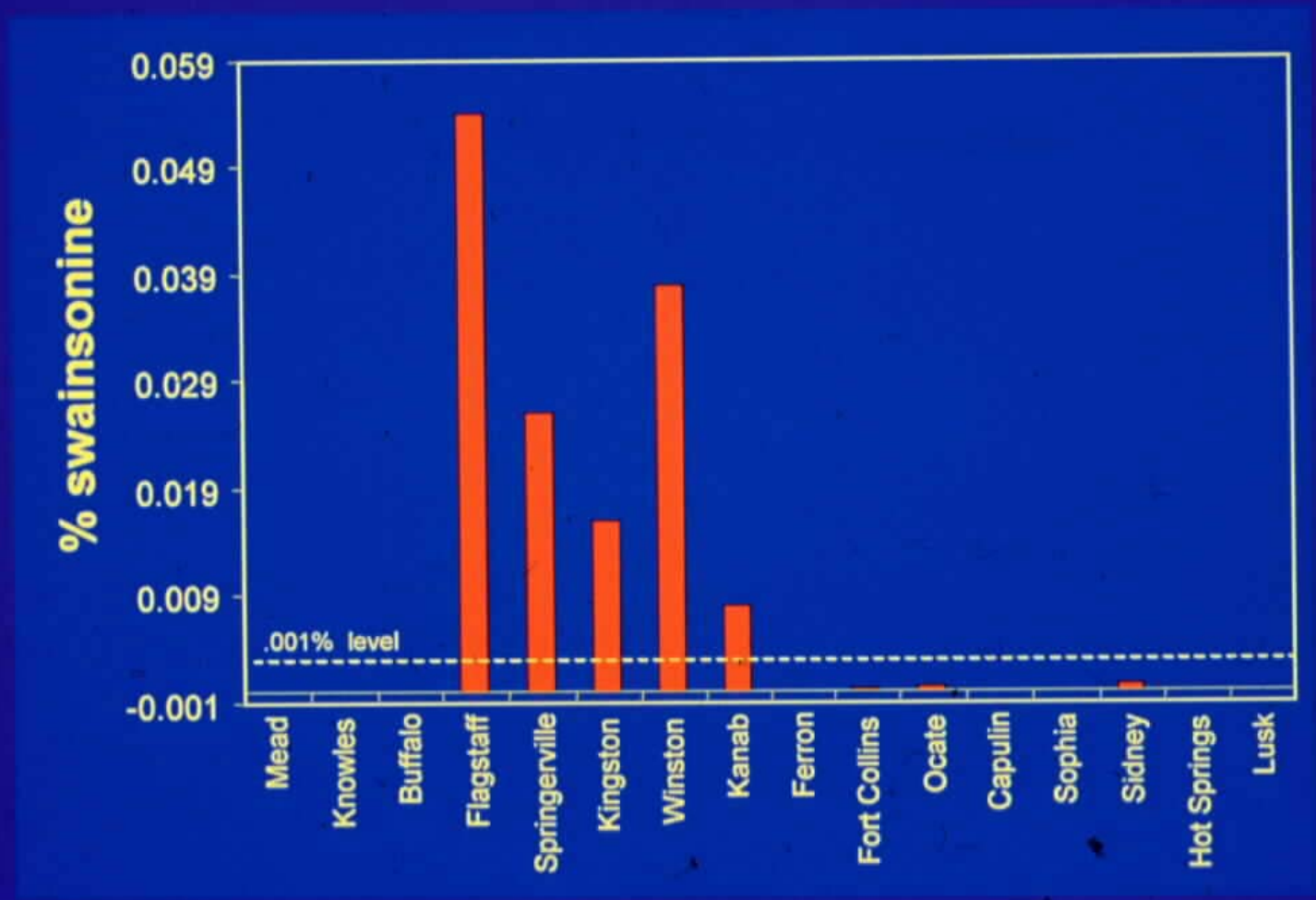
3. Plant Toxicity = toxin concentration in plant X toxic dose.



$L.D._{50}$ = 4.5 mg/kg


High
High
Toxicity
Palatability
RELATIVE TOXICITY
RELATIVE PALATABILITY
Toxic window
Low
Low
Bud
Flower
Pod

Mean Swainsonine Concentrations in *Oxytropis lambertii* Populations



B. Metabolic Fate of Toxins in Animal

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1. Target compounds for diagnostics.

B. Metabolic Fate of Toxins in Animal

1. Target compounds for diagnostics.

2. Mechanism of toxicity.

C. Diagnosis of Poisonous Plant Intoxications.

University of Idaho
Analytical Laboratory
Holm Center
Moscow, ID 83843
208-885-7081
FAX 208-885-8937

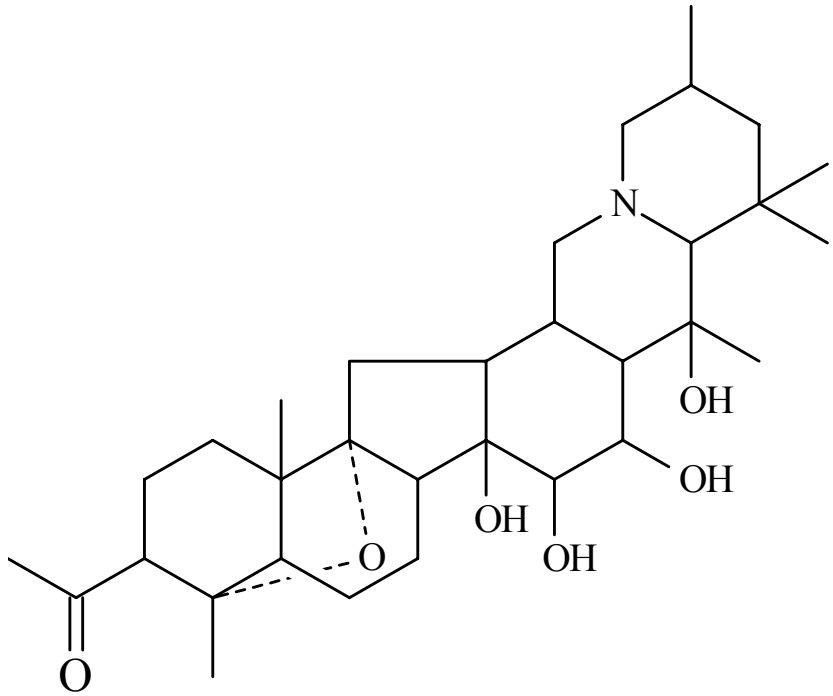
Dr. Dale Gardner
USDA-ARS Poisonous Plant Research Laboratory
1150 East 1400 North
Logan, UT 84321
Phone: 801.752.2941

Dr. Gardner: I am enclosing a blood sample and two samples of frozen rumen contents from a dead cow from the Rigby, ID area. Seven dead cows out of a group of 210 were found dead in a high mountain pasture, with heavy evidence of grazing death camas. Dr. Richard Old is identifying the species of death camas. I had emailed Bryan about the possibility of testing for zygacine in the rumen contents. This would make a nice teaching case for our students. So if you can, I would appreciate it, and please do not hesitate to send a bill (within my budget☺) to defray the cost. You can email or FAX the results; whatever is easier.

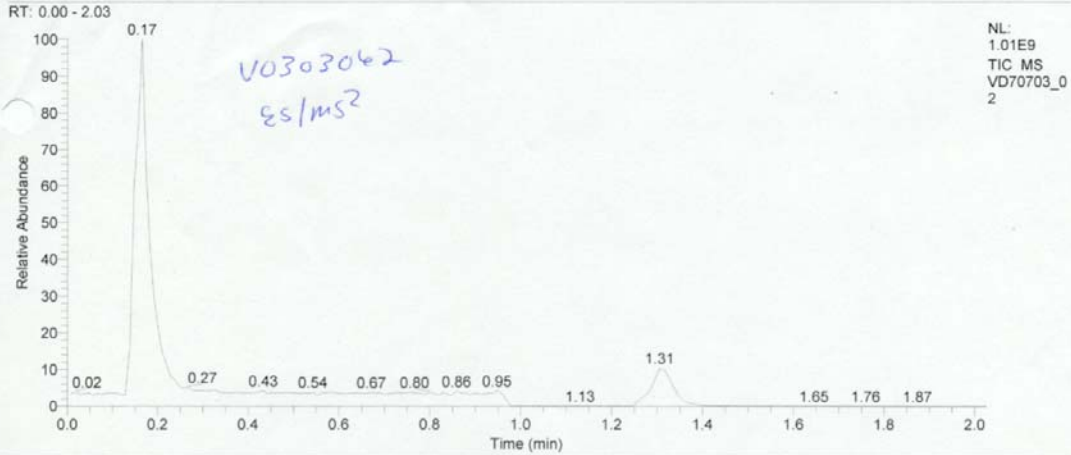
Thank you so much. I can try and provide you with any more information you think you might like, and I can always query the client again.

Very truly yours,

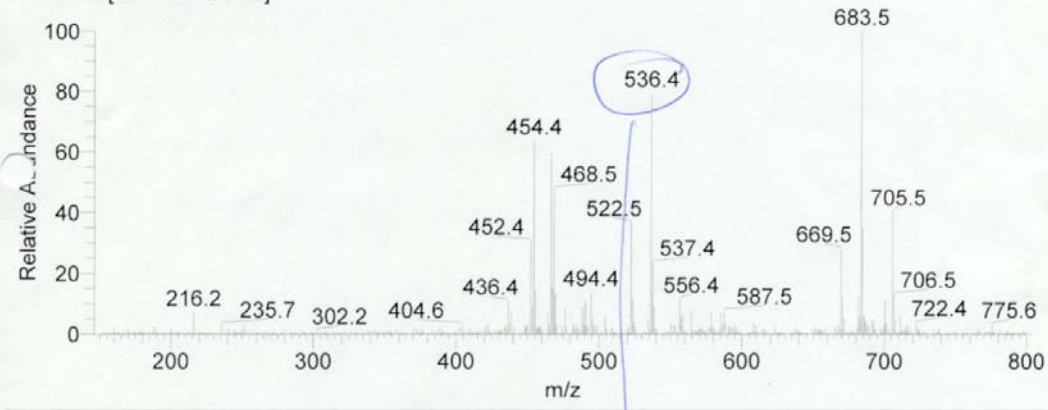
Patricia Talcott, MS,DVM,PhD,DABVT
Veterinary Toxicologist, Associate Professor
Phone: 208.885.6109
FAX: 208.885.8937
ptalcott@uidaho.edu


N
OH
OH
OH
OH
O
O

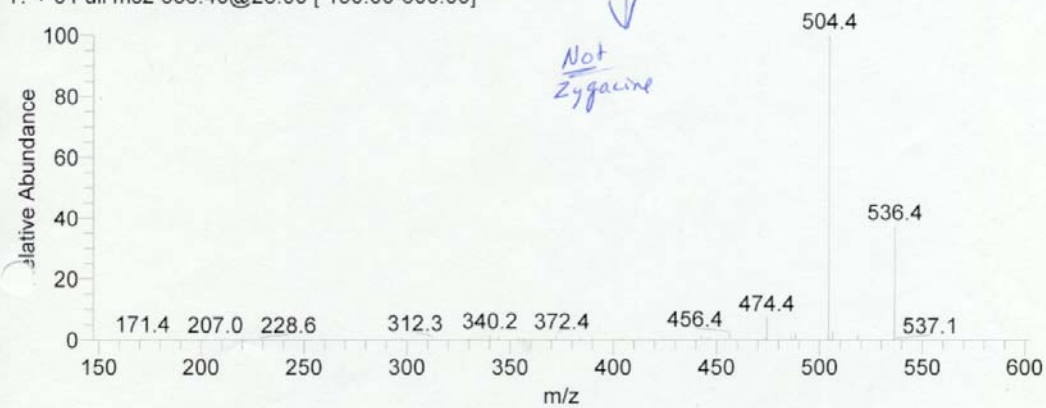
C:\Xcalibur\data\Vd70703_02 07/07/03 04:20:52 RUMEN FLUID EXT FOR ZYGACINE



VD70703_02#14-20 RT: 0.14-0.19 AV: 7 NL: 4.28E7
T: + c ms [150.00-800.00]

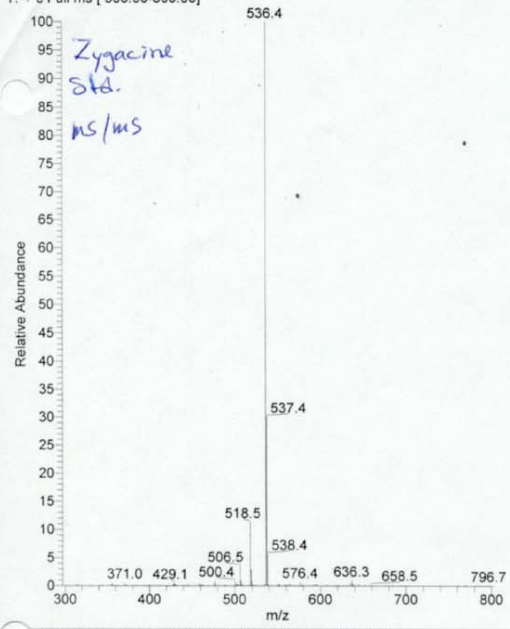


VD70703_02#107-110 RT: 1.28-1.33 AV: 4 NL: 4.49E7
T: + c Full ms2 536.40@28.00 [150.00-600.00]

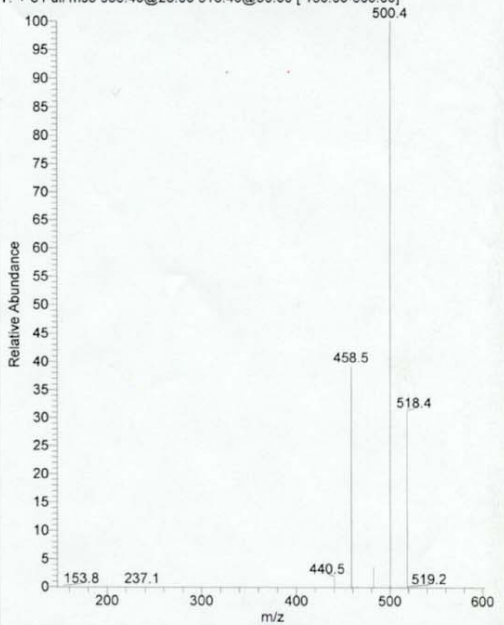


C:\Xcalibur\data\Zg52102_01 05/21/02 09:52:30 zygacine

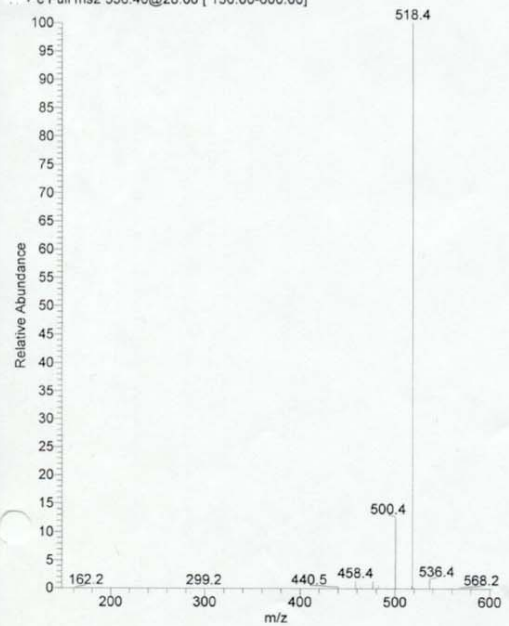
ZG52102_01#102-111 RT: 1.08-1.16 AV: 10 NL: 5.90E7
T: + c Full ms [300.00-800.00]



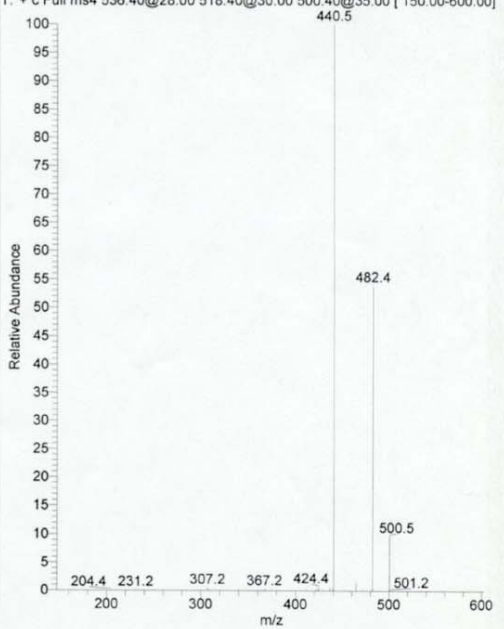
ZG52102_01#261-267 RT: 5.02-5.14 AV: 7 NL: 3.03E7
T: + c Full ms3 536.40@28.00 518.40@30.00 [150.00-600.00]



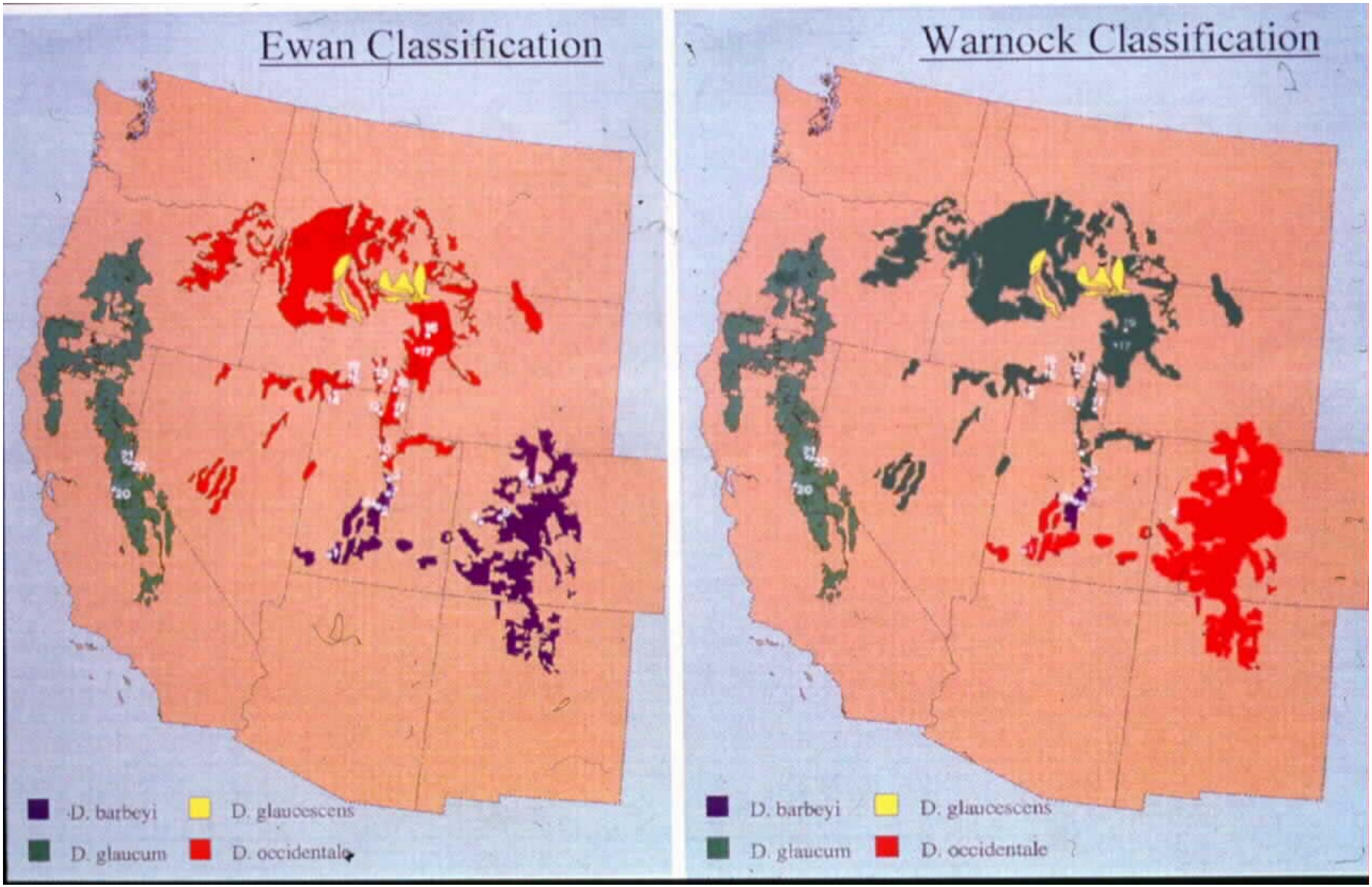
52102_01#230-239 RT: 4.02-4.20 AV: 10 NL: 4.59E7
+ c Full ms2 536.40@28.00 [150.00-600.00]

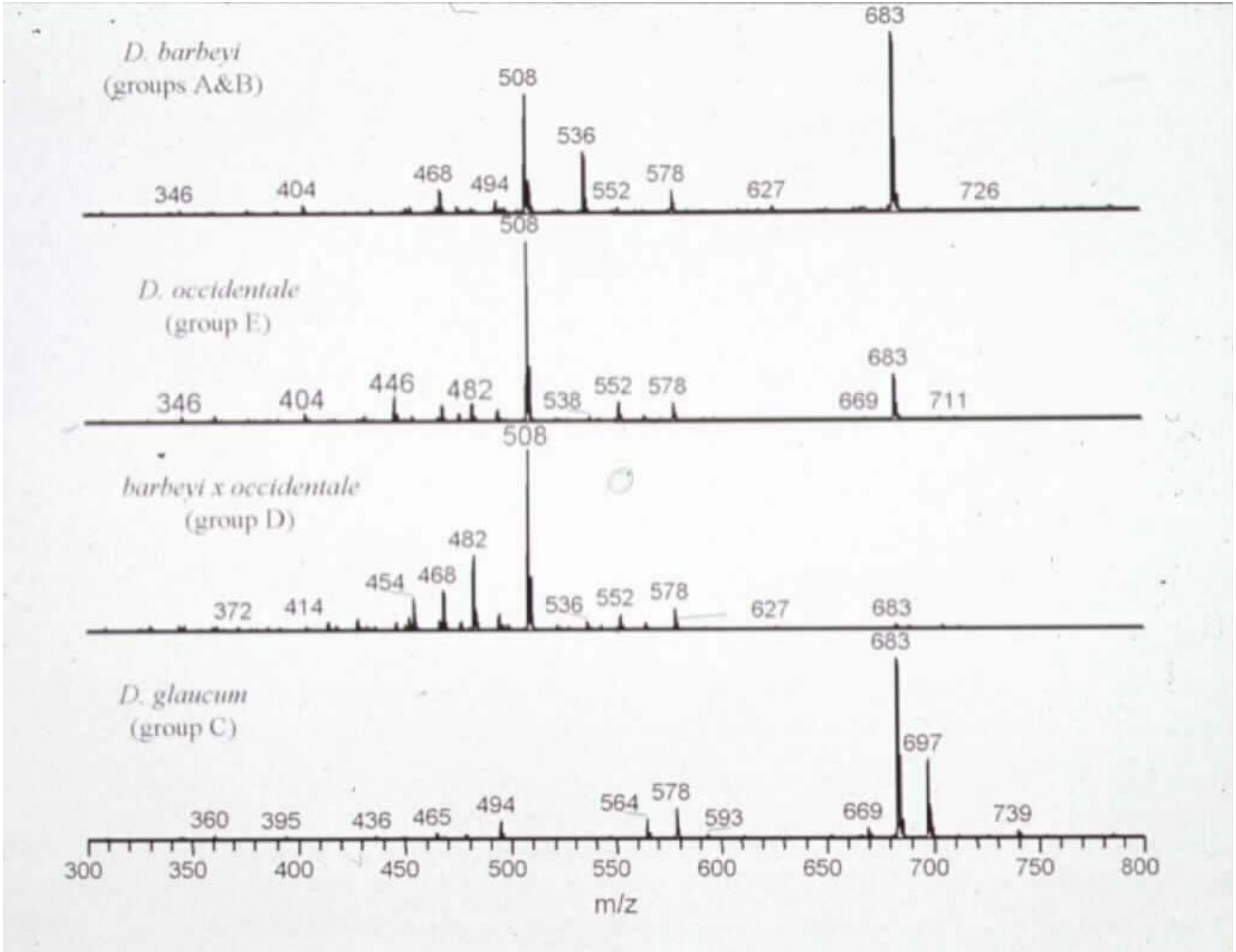


ZG52102_01#287-291 RT: 5.93-6.04 AV: 5 NL: 1.01E7
T: + c Full ms4 536.40@28.00 518.40@30.00 500.40@35.00 [150.00-600.00]



D. Plant Taxonomy = Chemotaxonomy.


Ewan Classification
D. barbeyi
D. glaucescens
D. glaucum
D. occidentale
Warnock Classification
D. barbeyi
D. glaucescens
D. glaucum
D. occidentale


D. barbeyi
(groups A&B)
683
508
536
468
494
578
346
404
552
627
726
508
D. occidentale
(group E)
683
446
482
346
404
538
552
578
669
711
508
barbeyi x occidentale
(group D)
482
454
468
372
414
536
552
578
627
683
683
D. glaucum
(group C)
697
578
360
395
436
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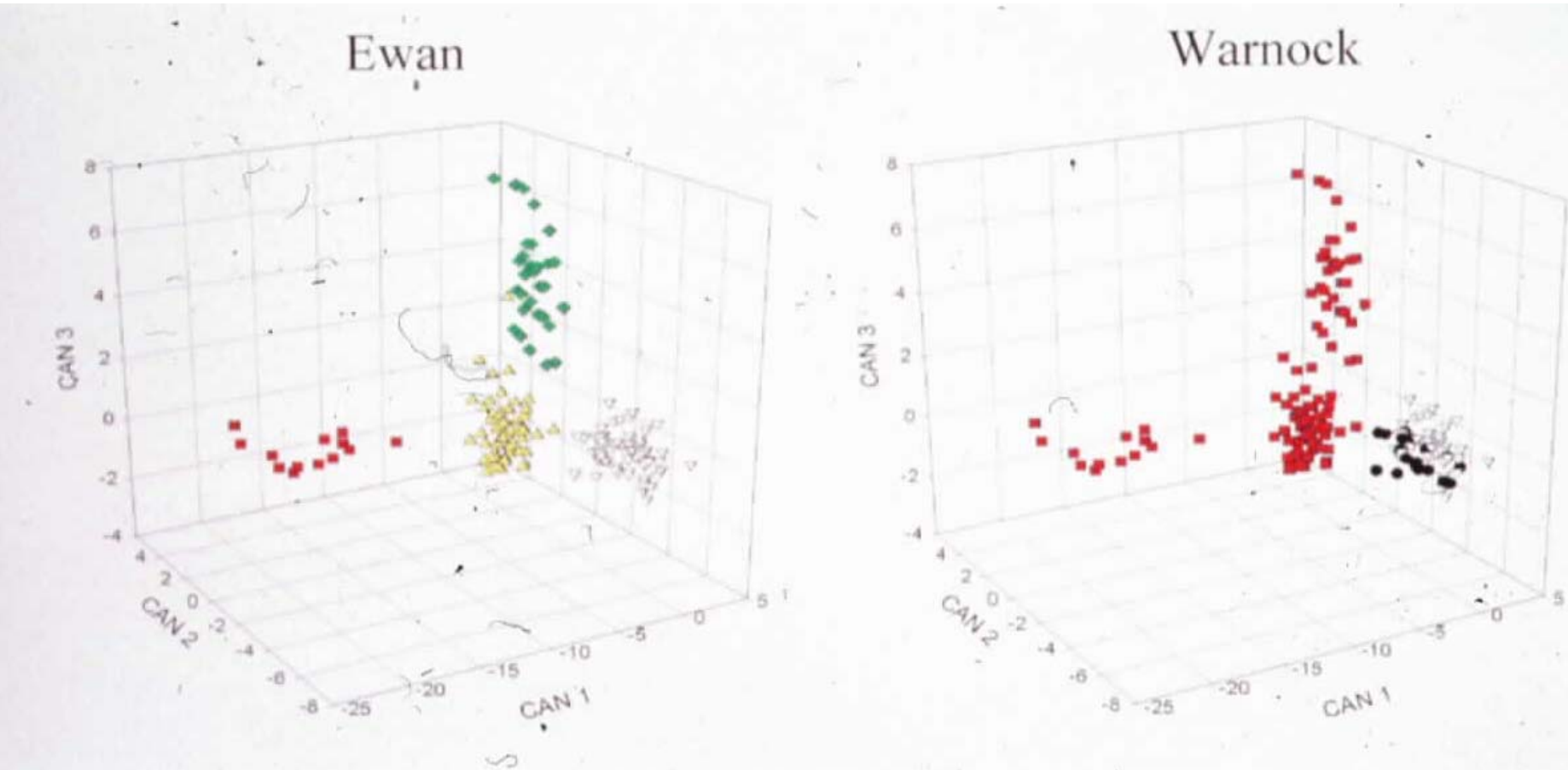
494
564
593
669
739
300
350
400
450
500
550
600
650
700
750
800
m/z


Ewan
Warnock
CAN 3
CAN 2
CAN 1