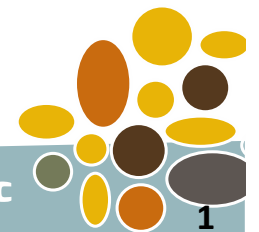


# Lupins – not just cattle feed!

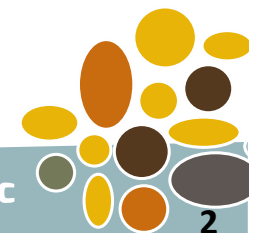
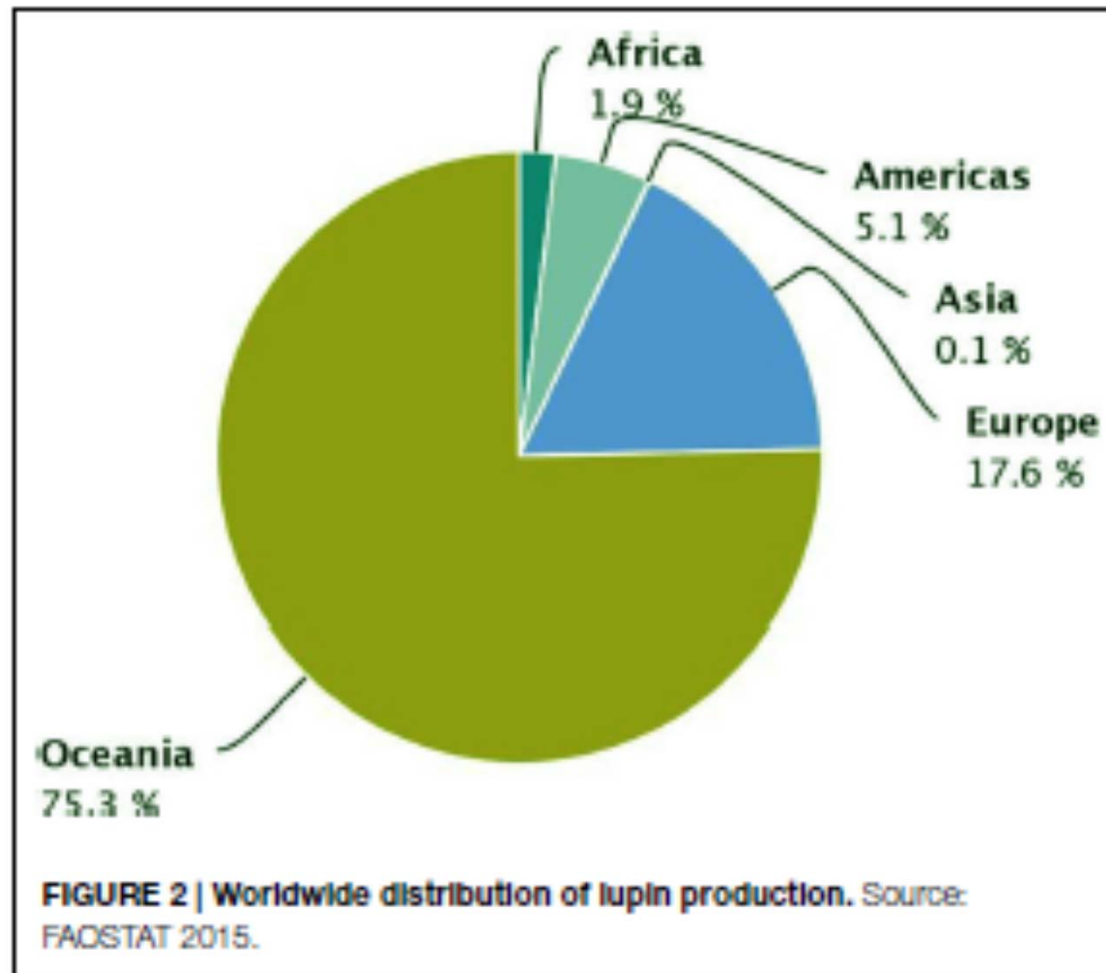
Presented

By

Philip G. Kerr



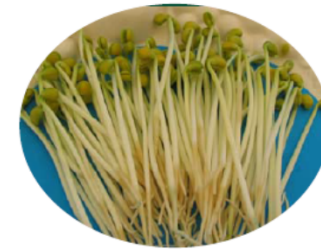
# World lupin production



# Lupin as a 'superfood'

## Whole seed

- Asian Bean sprouts (*concept*)  
36% yield advantage cf soy & mung  
Crispier texture, higher sensory rating



## Lupin Hulls

- High Fibre supplements (*product*)  
Vitafiber (Avelup Chile)
- High Fibre Cereals (*gluten free*)  
A patent has been granted for an extruded high fibre product similar to Kellogg's All- Bran®



## Lupin Kernels

- Asian Fermented Foods  
Miso, Shoyu (soy sauce) and Tempe



# Lupin as a 'superfood'

## Bioactives:

- Gamma-conglutin - antidiabetic
- Carotenoids - antioxidants
  - Lutein & Zeaxanthin - age related macular degeneration
- Lupeol (oil fraction) - anticancer (melanoma)
- Peptides - skin rejuvenation (production of collagen)



# Lupin cultivars under investigation



Barlock



Gunyidi



Jenabillup



Jindalee



Jurien



Mandelup



Luxor

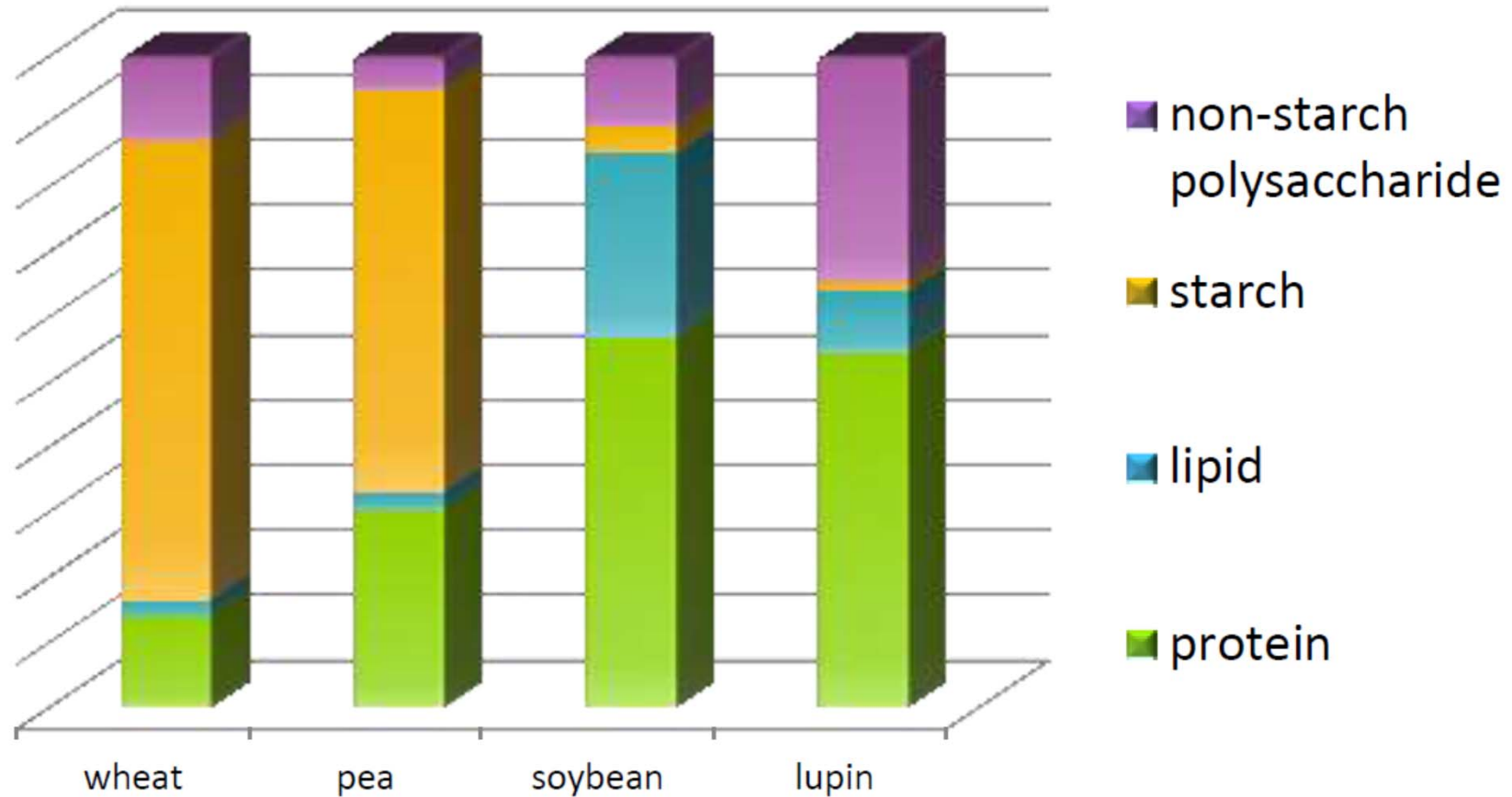


Rosetta



WK388

# Proximates: Lupin vs other grains



Source: [www.irwinvalley.com.au](http://www.irwinvalley.com.au)



# Lupin vs Soy

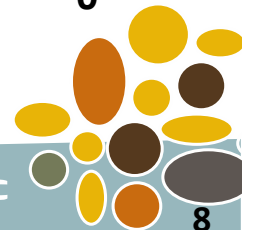
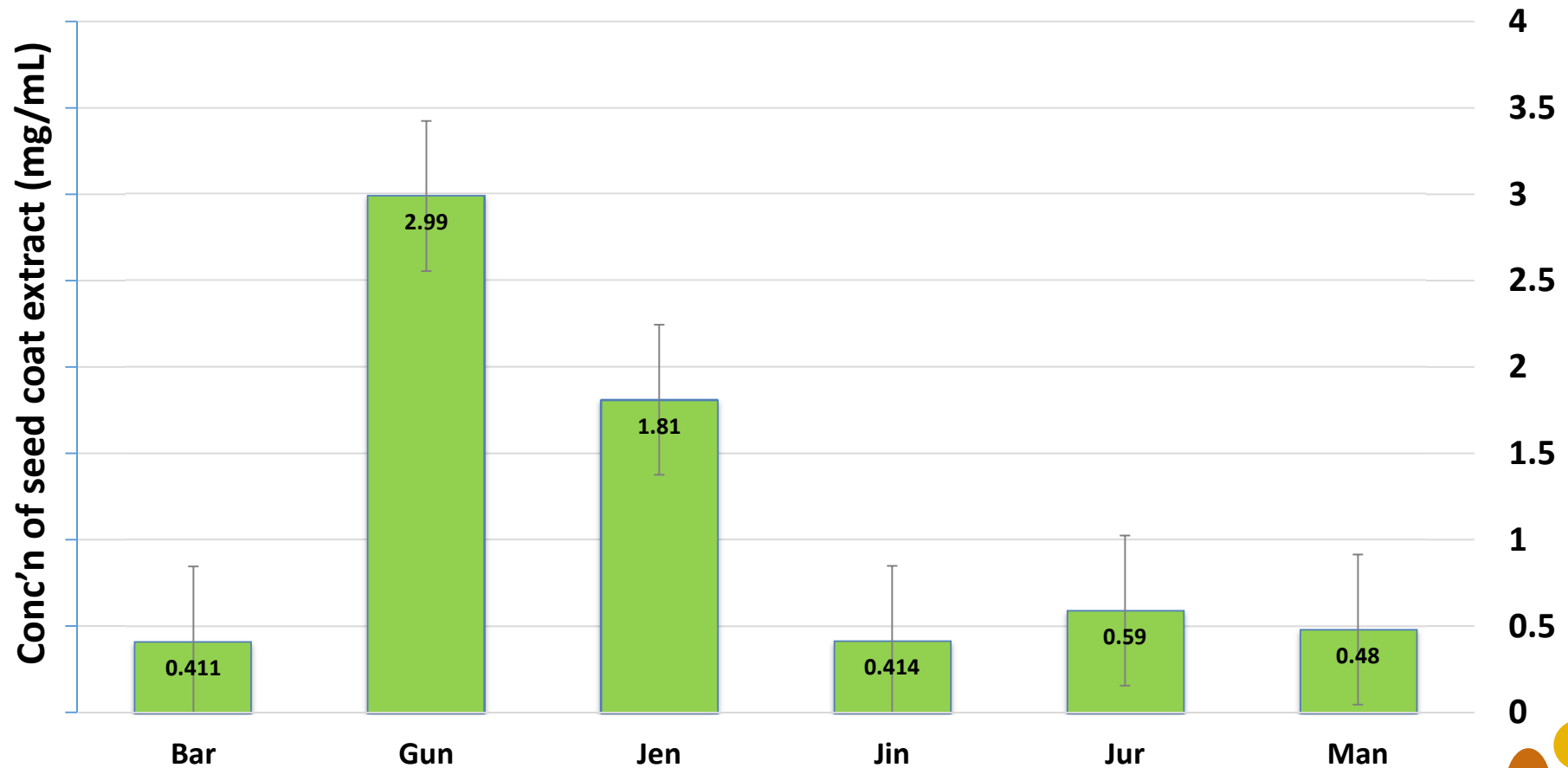
Raw Full Fat Lupin Flour	Raw Full Fat Soy Flour
GMO Free	GMO
Does Not require heat treatment	MUST be heat treated
Lower Fat (6-7%)	Higher Fat (23%)
High Fibre (36%)	Lower Fibre (12%)
Stable shelf life	Short shelf life
Lower rancidity potential	Higher rancidity potential
Higher anti-oxidant potential	Lower anti-oxidant potential
No Trypsin Inhibitors	High Levels of Trypsin Inhibitor
No Lectin (heamagglutinins)	Contains Lectins
Low level Saponins	High Level Saponins
Half the level of Phytic Acid of Soy	Double the level of Phytic Acid of Lupin

Source: [www.irwinvalley.com.au](http://www.irwinvalley.com.au)



# Antidiabetic potential

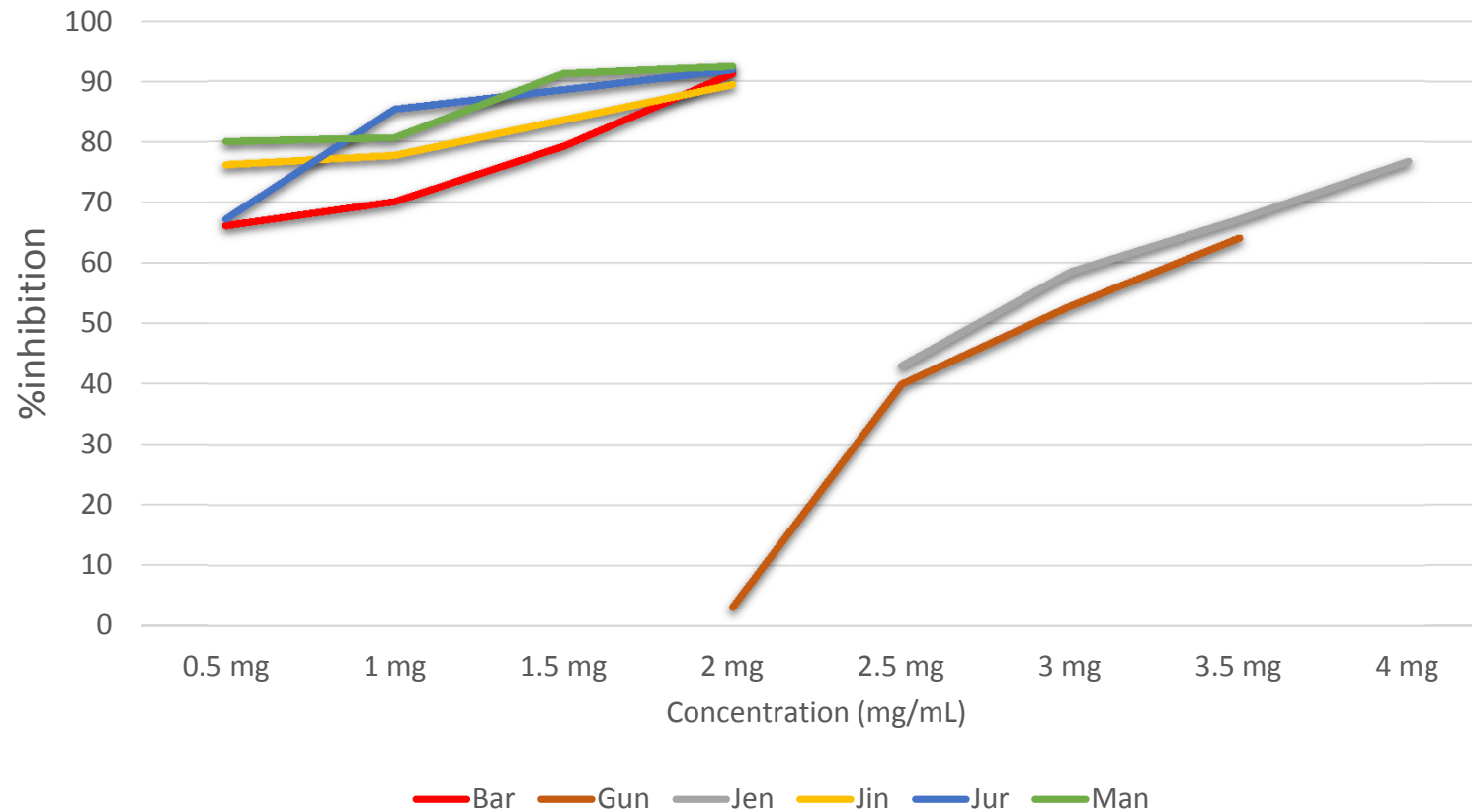
IC<sub>50</sub> value of methanol extract of seed coat vs  $\alpha$ -glucosidase





# Antidiabetic potential

$\alpha$ -glucosidase inhibition activity of *L. angustifolius* cultivars



No alpha glucosidase inhibition activity was observed for *L. albus* cultivars in the given concentration (0.5 to 5 mg/L)

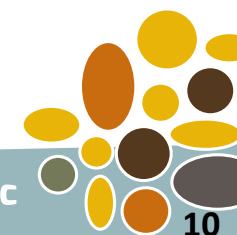


# Anticancer potential

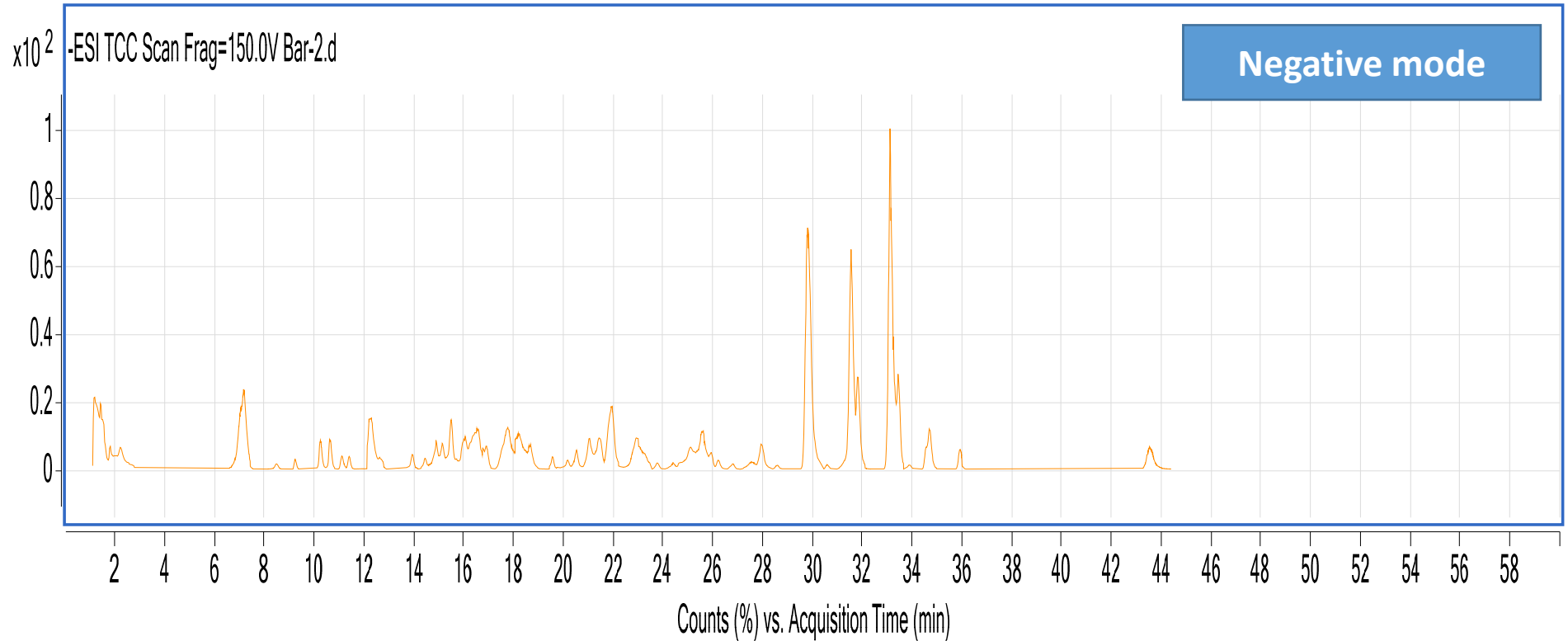
Observed apoptosis against MIA PaCa-2 pancreatic cell line at 4 hrs.

Lupin Cultivars	% Apoptosis (2.5 mg/mL)	% Apoptosis (1.0 mg/mL)	IC <sub>50</sub>
<i>L. ang.</i> Barlock	59.30 ± 1.10	0.75 ± 0.36	2.26
<i>L. ang.</i> Gunyidi	37.55 ± 3.36	Nil	3
<i>L. ang.</i> Jenabillup	Nil	Nil	Nil
<i>L. ang.</i> Jindalee	Nil	Nil	Nil
<i>L. ang.</i> Jurien	Nil	Nil	Nil
<i>L. ang.</i> Mandelup	Nil	Nil	Nil
<i>L. alb.</i> Luxor	41.02 ± 5.24	16.36 ± 1.01	3.05
<i>L. alb.</i> Rosetta	67.79 ± 2.84	Nil	<b>2.11</b>
<i>L. alb.</i> Wk388	31.89 ± 6.98	Nil	3.35

*Data are means of three replicates with standard deviations.*



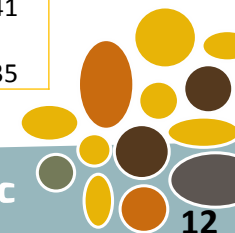
# The chemistry – via LC/MS & GC/MS



# The chemistry unfolded!

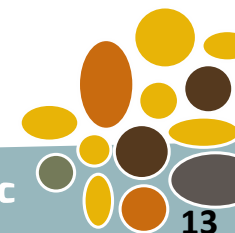
Compounds Identified	Mass (DB)	Formula (DB)	Score (MFG)	RT
<b>Non-fatty acid compounds</b>				
Cpd 1: Stachyose	666.2219	C24 H42 O21	96.14	1.167
Cpd 2: Levan	504.169	C18 H32 O16	95.78	1.206
Cpd 13: Kaempferol 3-xylosyl-(1->3)-rhamnosyl-(1->6)-galactoside	726.2007	C32 H38 O19	99.24	7.029
Cpd 15: Chrysoeriol 6-C-glucoside-8-C-arabinopyranoside	594.1585	C27 H30 O15	96.41	7.337
Cpd 21: Veronicafolin	360.0845	C18 H16 O8	96.48	13.96
Cpd 25: Quercetin 3-methyl ether	316.0583	C16 H12 O7	97.18	14.901
Cpd 28: 8-Hydroxydaidzein	270.0528	C15 H10 O5	95.2	15.152
Cpd 29: 5,8,2'-Trihydroxy-7-methoxyflavone	300.0634	C16 H12 O6	96.72	15.507
Cpd 31: Scutevulin	300.0634	C16 H12 O6	99.11	17.756
Cpd 43: Dehydrosoyasaponin I	940.5032	C48 H76 O18		17.756
Cpd 33: 8-C-Methylquercetin 3-methyl ether	330.074	C17 H14 O7	81.23	17.890
Cpd 30: Primulasaponin	1104.5716	C54 H88 O23		16.151
Cpd 50: Salannin	596.2985	C34 H44 O9	85.32	20.528
Cpd 54: Lauryl hydrogen sulfate	266.1552	C12 H26 O4 S	98.41	21.441
Cpd 69: 1 $\beta$ -Hydroxy-3-oxo-5 $\beta$ -cholan-24-oic Acid	390.277	C24 H38 O4	94.84	25.935

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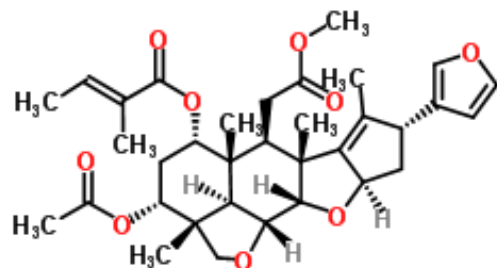


# The chemistry

Compounds Identified	Mass (DB)	Formula (DB)	Score (MFG)	RT
<b>Fatty acids</b>				
Cpd 73: 4-hydroxy-pentadecanoic acid	258.2195	C15 H30 O3	99.34	27.98
Cpd 74: 15-oxo-hexadecanoic acid	270.2195	C16 H30 O3	86.32	28.598
Cpd 75: 14S-hydroxy-hexadecanoic acid	272.2351	C16 H32 O3	98.72	29.828
Cpd 79: 17-hydroxy-heptadecanoic acid	286.2508	C17 H34 O3	96.42	31.564
Cpd 82: 17-hydroxy-heptadecanoic acid	286.2508	C17 H34 O3	99.88	31.835
Cpd 83: 14-hydroxy stearic acid	300.2664	C18 H36 O3	99.27	33.15
Cpd 84: 14-hydroxy stearic acid	300.2664	C18 H36 O3	99.25	33.459
Cpd 85: 14-hydroxy stearic acid	300.2664	C18 H36 O3	85.18	34.549
Cpd 86: 2-hydroxy-nonadecanoic acid	314.2821	C19 H38 O3	97.55	34.123
Cpd 90: 20-hydroxy-eicosanoic acid	328.2977	C20 H40 O3	90.05	35.933

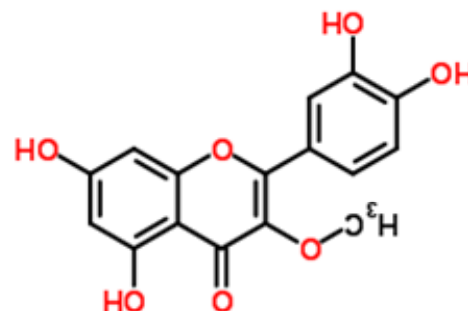


# Some structures identified

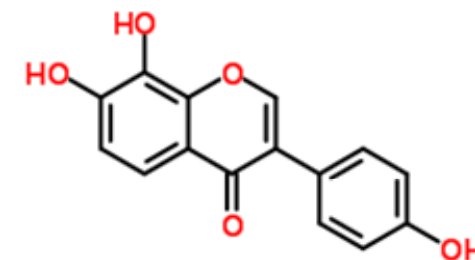


**Salannin**  
(antifeedant activity)

Gopalakrishnan et al, *Molecules*, 2001

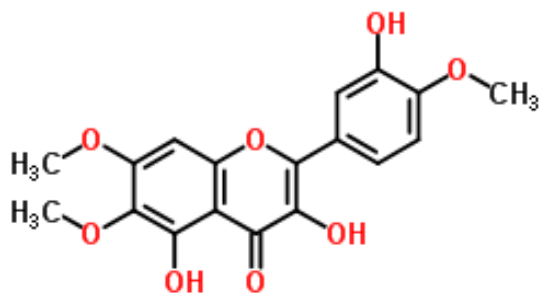


**Quercetin 3-methyl ether**

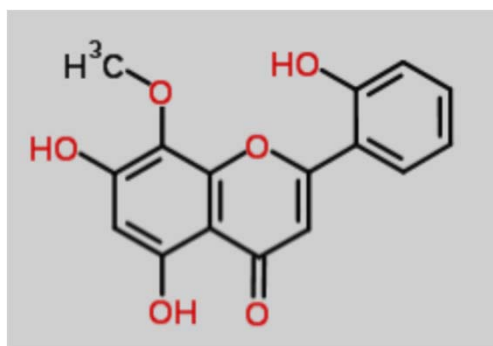


**8-Hydroxydaidzein**  
(Antioxidant Activity)

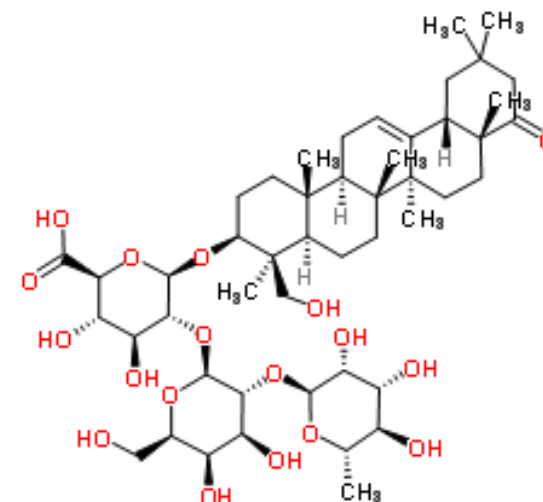
Rimbach G et al, *Xenobiotica*, 2003



**Veronicafolin**



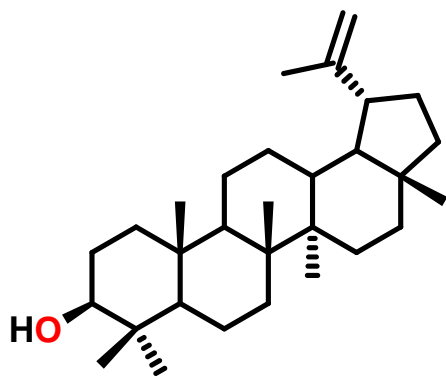
**Scutevulin**



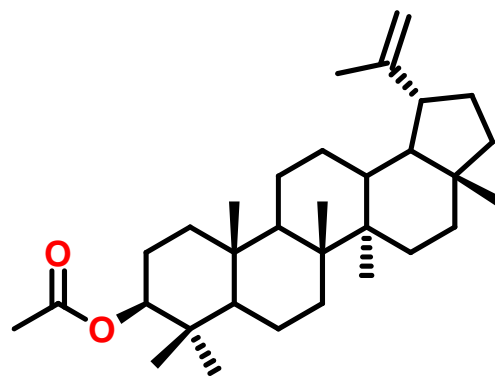
**Dehydrosoyasaponin I**  
(Anticancer activity)

Mezrag, Abderrahmane et al,  
*Pharmacol Arc*, 2014

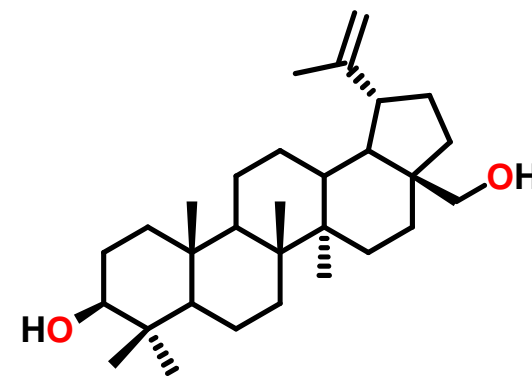
# Some triterpenoids



**Lupeol:** Anti-tumour



**Lupeol acetate:** Anti-hyperglycaemic  
Anti-ulcer



**Betulin:** anti-tumour

# Acknowledgements

**Prof. Dr. Chris Blanchard**

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Lecturer, School Biomedical Sciences

**School of Biomedical Sciences, Charles Sturt University**

**Functional Grain Centre, Charles Sturt University**

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