

POLYPHENOL CONTENT AND ANTIOXIDANT ACTIVITY OF POTATO TUBERS WITH COLORED FLESH: THEIR POTENTIAL ROLE IN ACRYLAMIDE FORMATION IN FRENCH FRIES



Diganta Kalita
Post Doctoral Research Associate
San Luis Valley Research Center
Colorado State University
<http://www.ppb.colostate.edu>

Why do we need “Antioxidant”

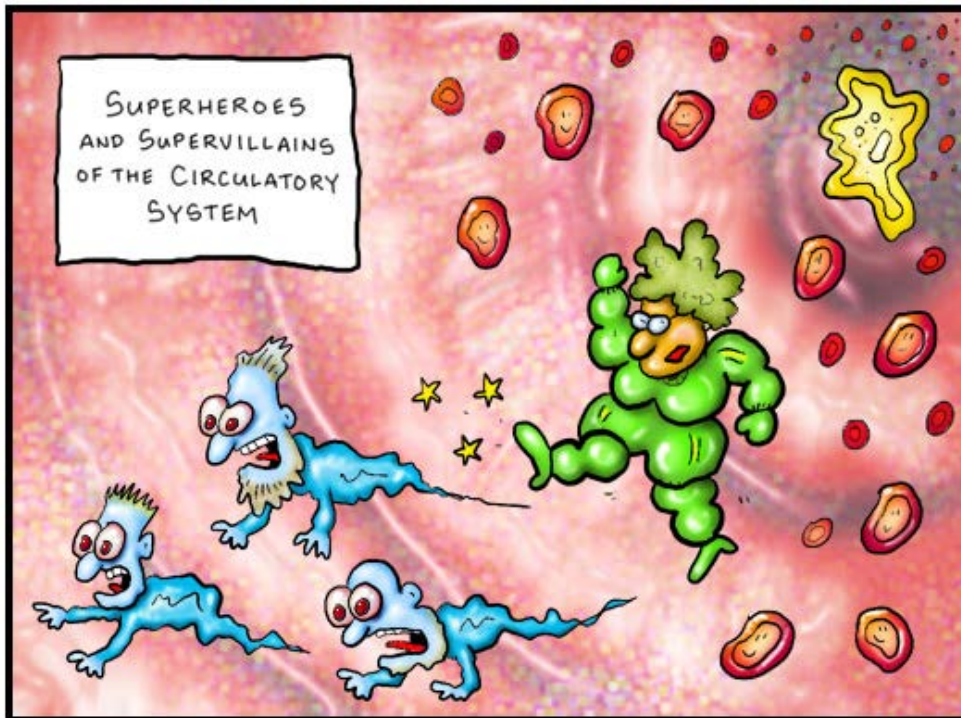


Free Radicals

(OH·, O₂⁻, ¹O₂)

Proteins Lipids DNA/RNA

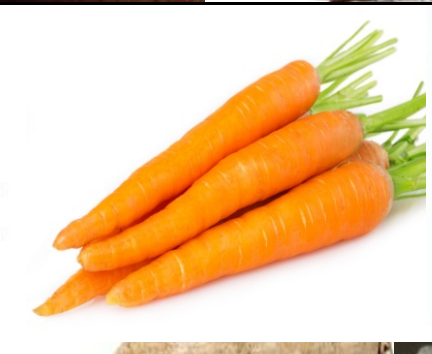
DOCTOR FUN



Auntie Oxidant kicks out the Free Radicals.

1. Cardiovascular diseases (CHD)
2. Cancers
3. Inflammatory diseases
4. Respiratory diseases
5. Diabetes mellitus
6. Cataract
8. Aging process
9. Others: Parkinson's disease, Alzheimer's disease etc

Sources of antioxidants in the diet



Potatoes....

4th major food after rice, wheat and maize

❖ Breeding new cultivars is gaining interest...

Colorado State University
San Luis Valley Research Center

Welcome to the
CSU Potato Program Website!

Contact Us:
San Luis Valley Research Center: 719-754-3594
Potato Certification Service: 719-754-3496

HOME ABOUT US HAPPENINGS PROGRAMS RESOURCE CENTER CONTACT US

CO97222-1R/R

Purple Majesty

Masquerade

Mountain Rose

CO97216-1P/P

CO99100-1RU

COLORADO STATE UNIVERSITY POTATO PROGRAM

Colorado has a long rich tradition of growing potatoes dating from the early 1880's and today is one of the top production areas in the US. The San Luis Valley is unique in that it is one of the largest, high altitude (7,600 ft.), irrigated crop production areas in the United States. The area is surrounded by 12,000-14,000 foot mountains. The Colorado State University potato program is based at the San Luis Valley Research Center which is engaged in various potato research programs include breeding and selection, pathology, crop management and field physiology, postharvest physiology, and seed certification.

<http://www.ppb.colostate.edu>



ALL ABOUT US

The first San Luis Valley Research Center was established in 1888 (the same year the



MEET OUR TEAM

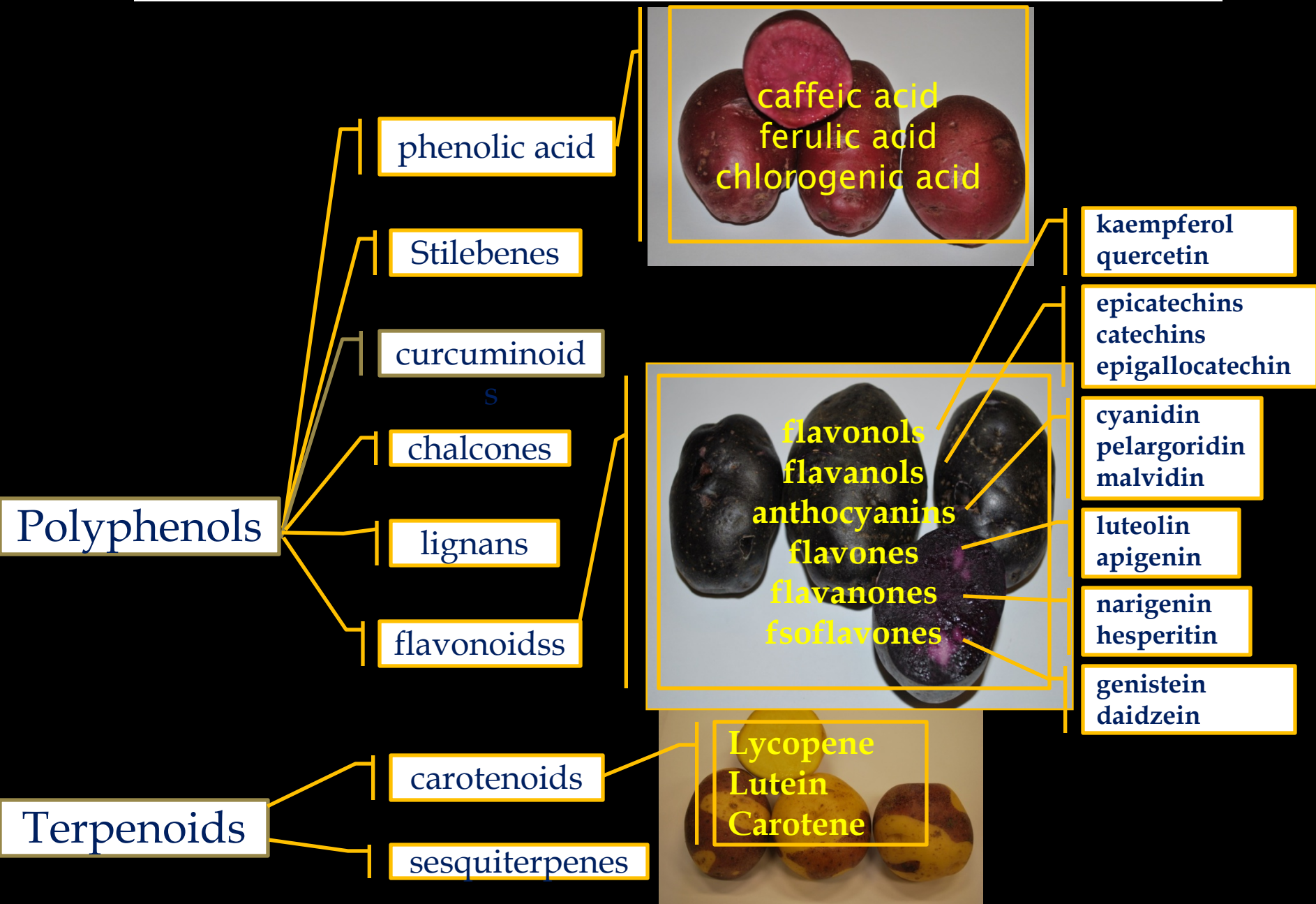
The Colorado State University Potato Program at the San Luis Valley Research



CONTACT US

Please click on the link below for the Potato Program Contact Information.

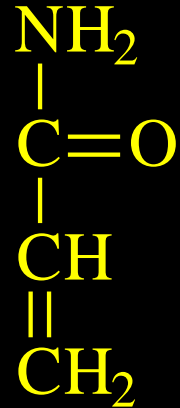
Important phytonutrients in fruits, vegetables and potato



Objective 1: Comparison of Polyphenol content and antioxidant activity of potato tubers with pomegranate and blueberries

What is Acrylamide?

- genotoxic
- neuro toxic
- Probably Carcinogenic (IARC, 1994)



Acrylamide

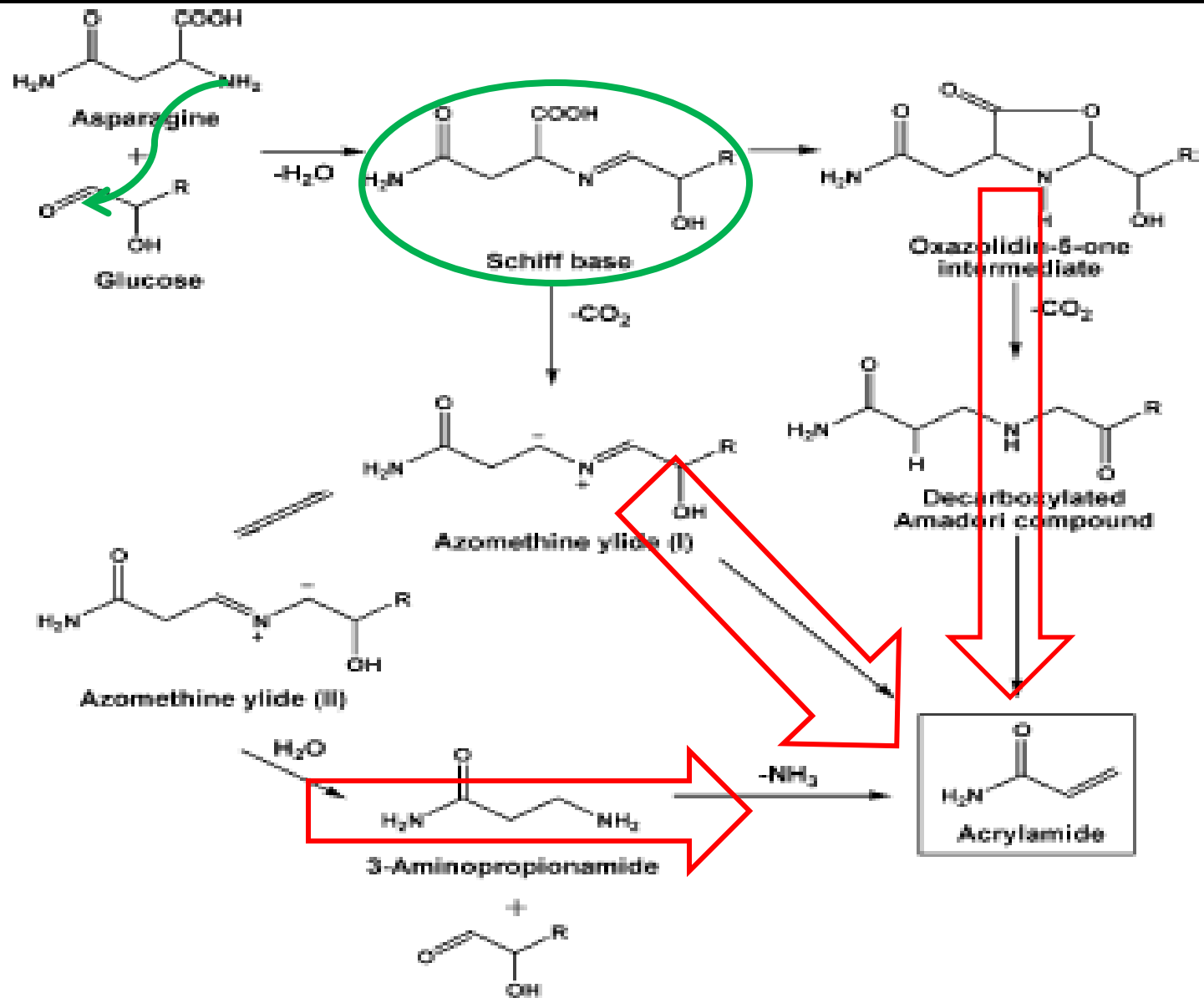
Acrylamide
in heated
food
2002
NEA

Free amino acid
+
reducing sugars

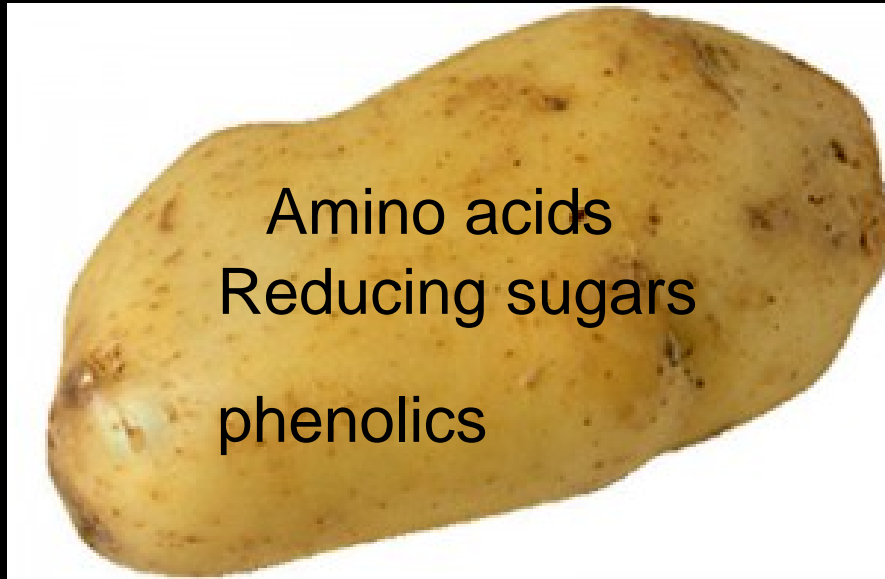
120 °C



Mechanism of Acrylamide formation



Acrylamide formation in French fries



Factors affecting :

- ✓ Content of asparagine & reducing sugars
- ✓ Time and temperature of cooking
- ✓ pH
- ✓ Surface-to-volume ratio

Solution....

- Breeding
- Adding/blanching
 - Citric acid, amino acid
 - Metal salts (Na, Ca, V)
 - Phenolics

Critical role of antioxidant on acrylamide formation

Antioxidant	Model system	Effect
caffeic acid, catechin, cinnamic acid, ferulic acid, epicatechin	aqueous	no reduction
caffeic acid, ferulic acid,	emulsion	reduction
TBHQ, BHA, BHT, ferulic acid, vitamin C	aqueous	reduction
oregano phenolic extract	potato	30% reduction
virgin olive oil phenolic extract	potato	45 % enhancement
Bamboo leaves extracts	potato	74 % reduction

Report with endogenous phenolic compounds was limited

Food Research International (2013), 54, 753-759

Objective 1: Polyphenol content and antioxidant activity of potato tubers comparison with pomegranate and blueberries

Objective 2: Role of polyphenols in Acrylamide formation in the French fries

METHODS

Measurement of Total phenolics

FCR method from methanolic extraction (GAE/g FW)

Antioxidant activity

➤ DPPH

DPPH radical-scavenging activity (%) = $[(A_{\text{control}} - A_{\text{sample}})/A_{\text{control}}] \times 100$
where A is the absorbance at 515 nm.

➤ ABTS

Monitoring absorbance of ABTS•+ radical at 734 nm

➤ ORAC

fluorescence conditions: excitation at 485 nm and emission at 520 nm.

ORAC value ($\mu\text{mol TE/g}$) = $hkc (S_{\text{sample}} - S_{\text{blank}}) / (S_{\text{Trolox}} - S_{\text{blank}})$, where h is the ratio between liters of juice and grams of fruits or vegetables, k is the dilution factor, and c is the concentration of Trolox in $\mu\text{mol/L}$

Extraction & Analysis of Acrylamide by GC-MS method

via bromination derivative

sample in water

Internal standard

homogenization

centrifuge

aqueous layer

Bromination reagent
(KBr, HBr, Br₂ solution)

ice bath overnight

Na₂S₂O₃

ethyl acetate (EA)

Sodium sulfate

concentrated EA

injected to GC-MS

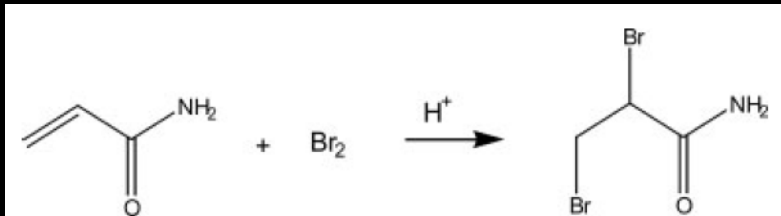


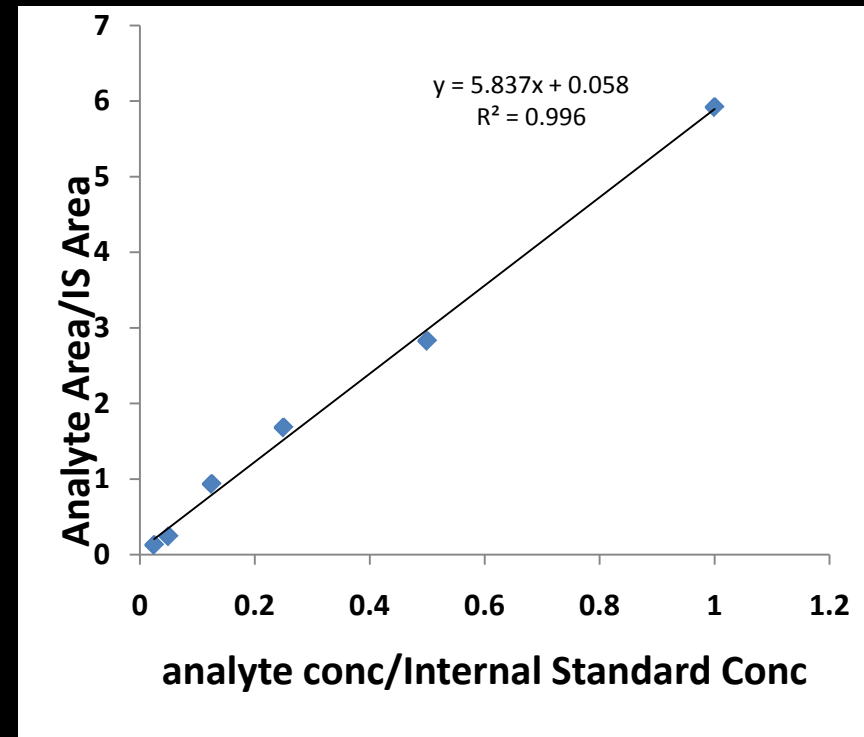
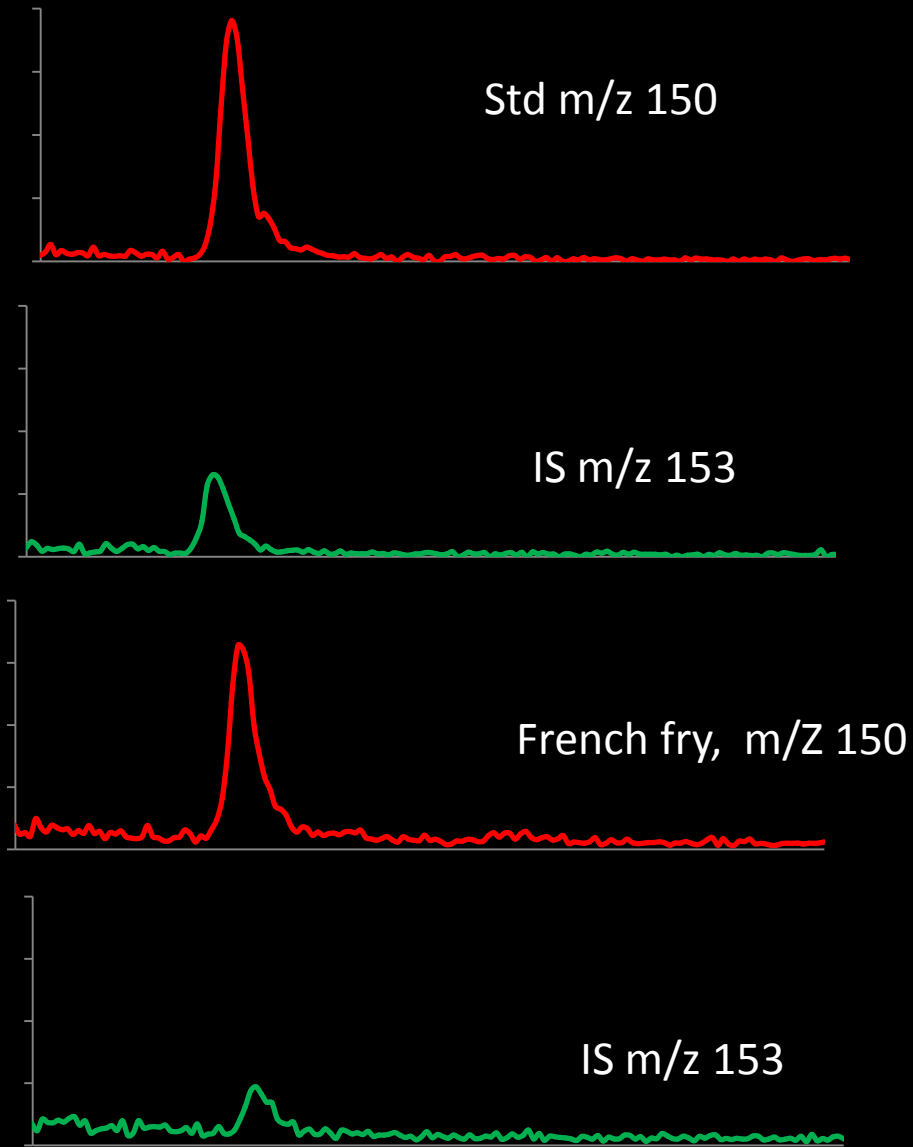
Fig. 1. Addition of bromine to acrylamide.

GC-MS Conditions

Apparatus	Varian Saturn 2000R
Column	CP-Sil 24CB, Agilent
Carrier gas	He
Flow rate	1 ml/min
Injection volume	1 ul
Injection temp	250 °C
Temp program	50 C 1min 100 C 2min 0.5 C/min 10 min, 100 C /min to 235 C
Retention time	8.091
Acquisition time	21.08 min
Ionisation	EI(70 eV)
Detection	SIM (Acrylamide m/z 150 & 152 internal St.153 & 155)

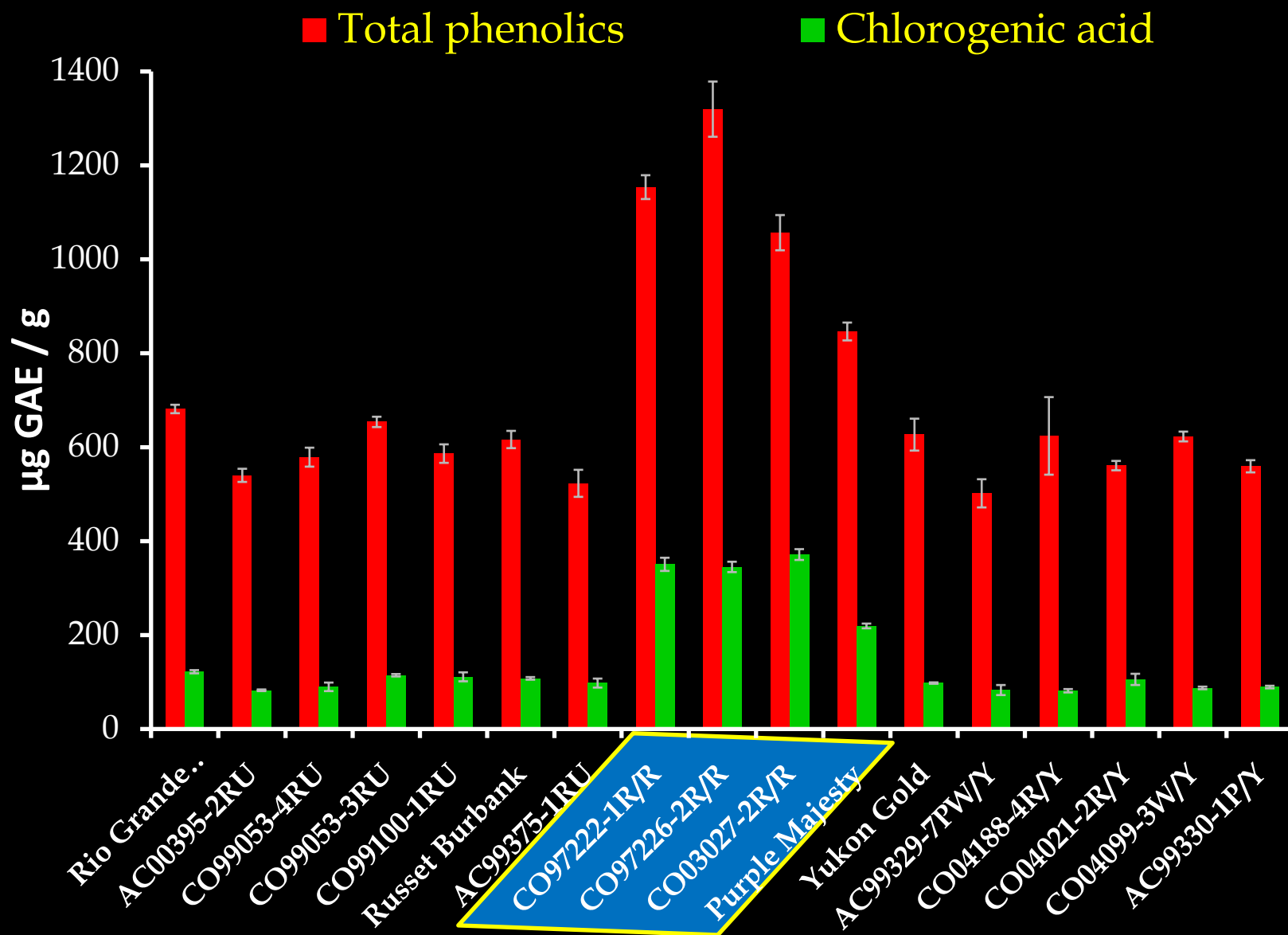
Representative chromatographs

Calibration curve

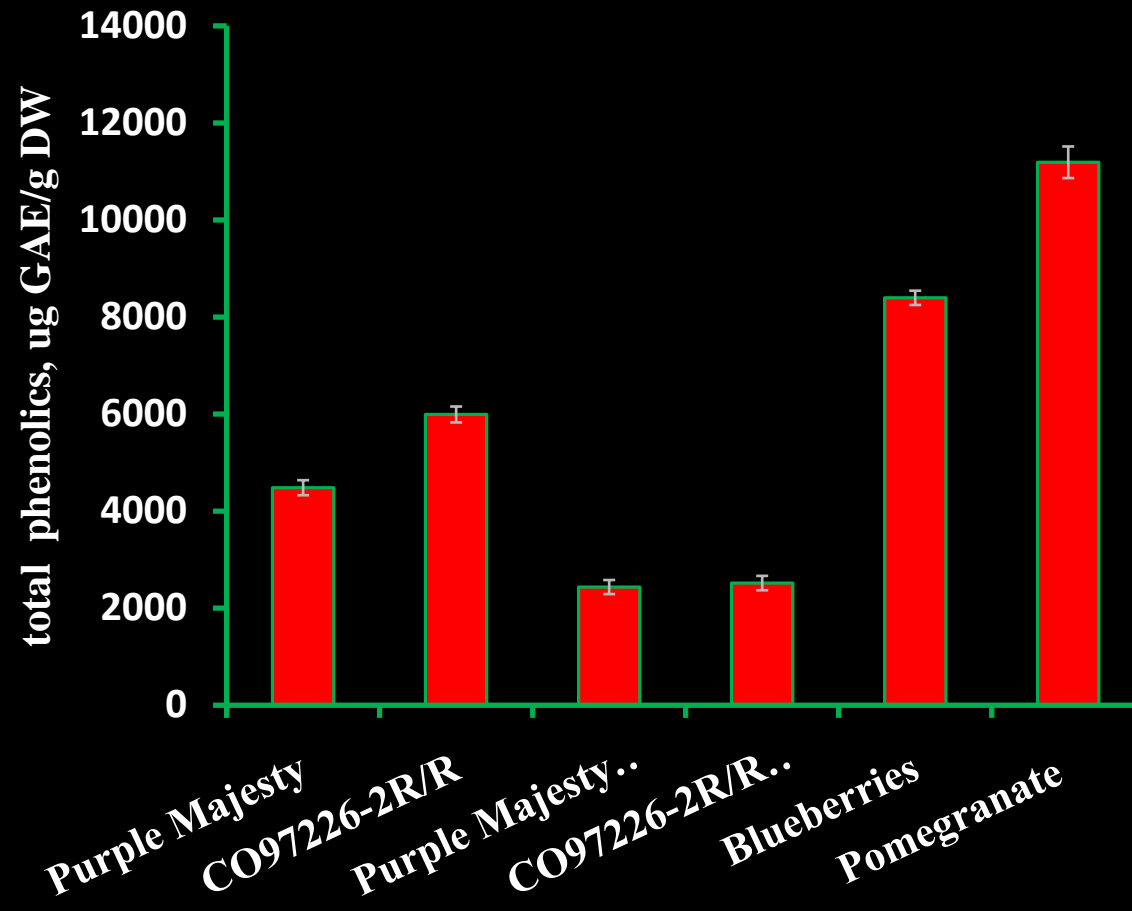


RESULTS

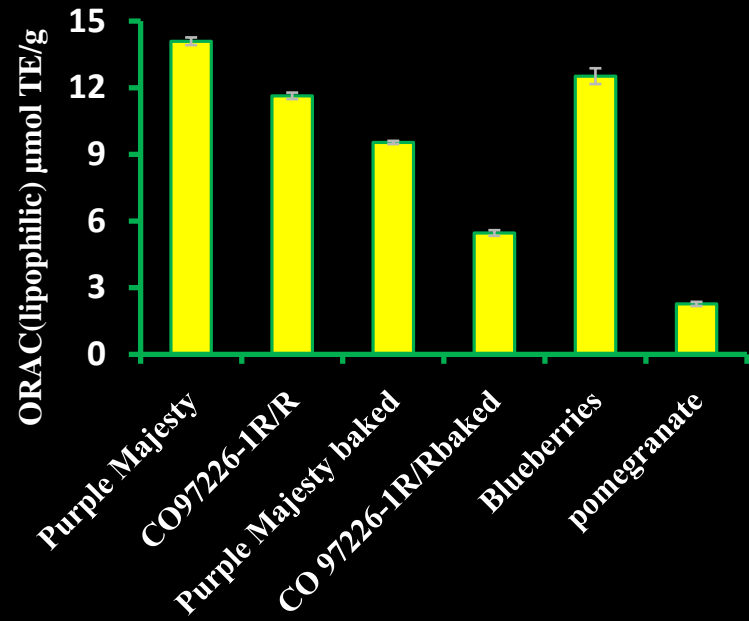
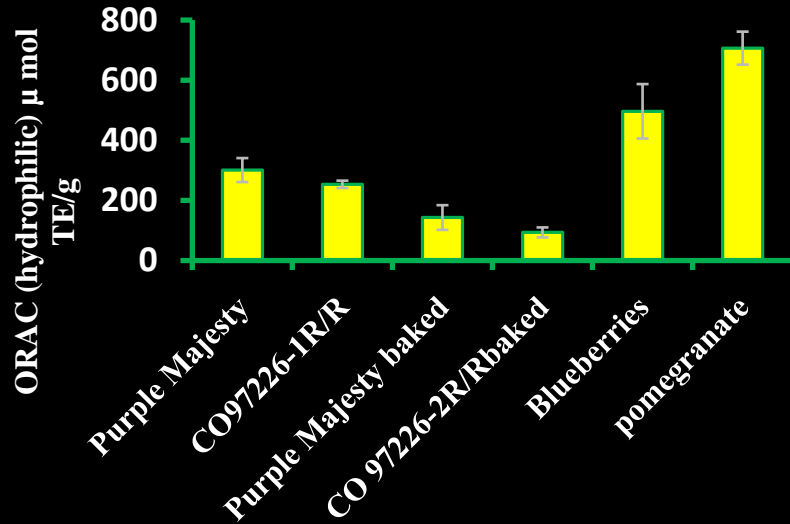
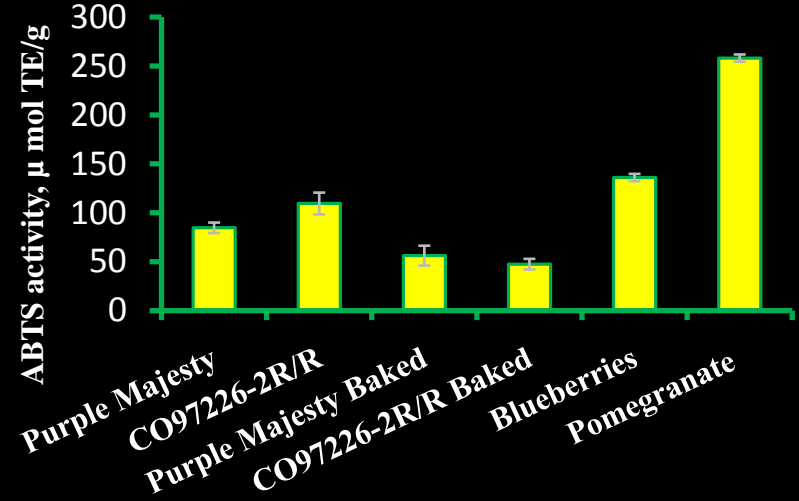
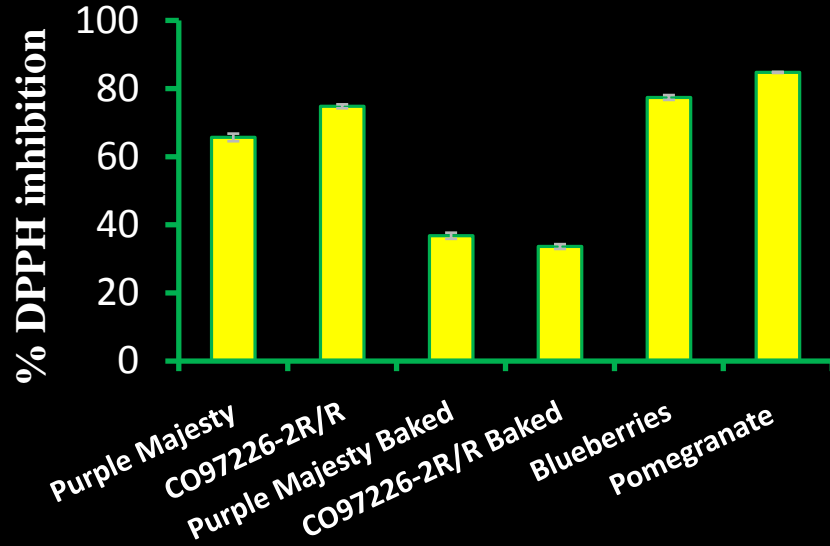
Total phenolics and chlorogenic acid in potato tubers



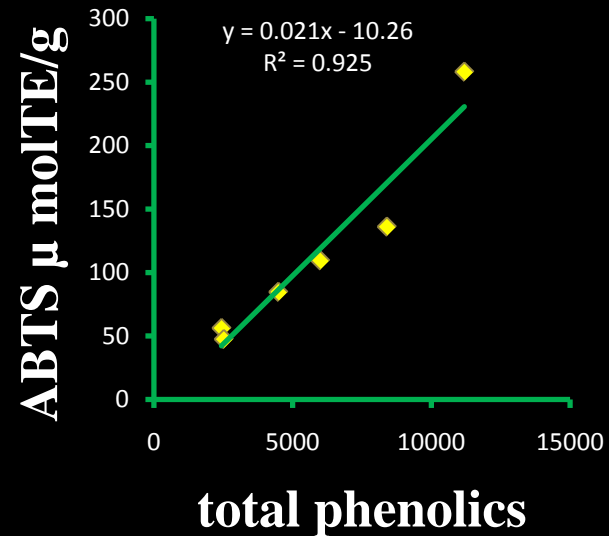
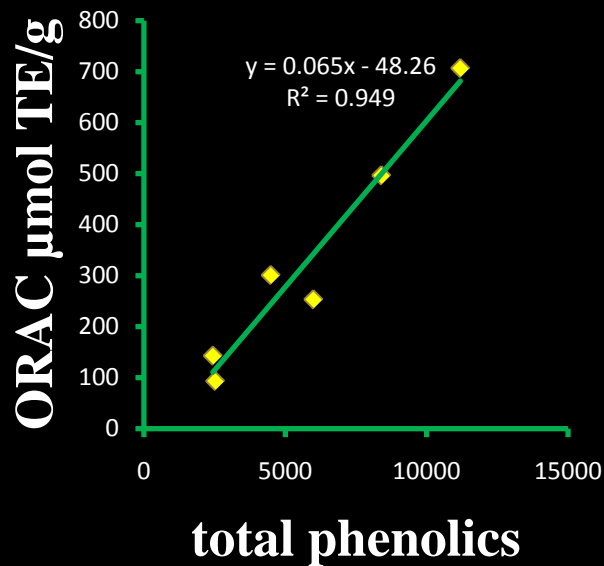
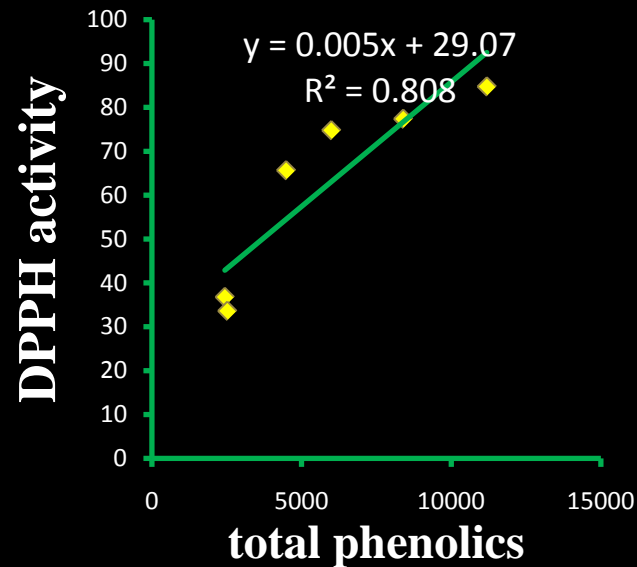
Total phenolics in potato, blueberries and pomegranate



Antioxidant activities in DPPH, ABTS and ORAC assays



Correlation between Total phenolics and antioxidant assays



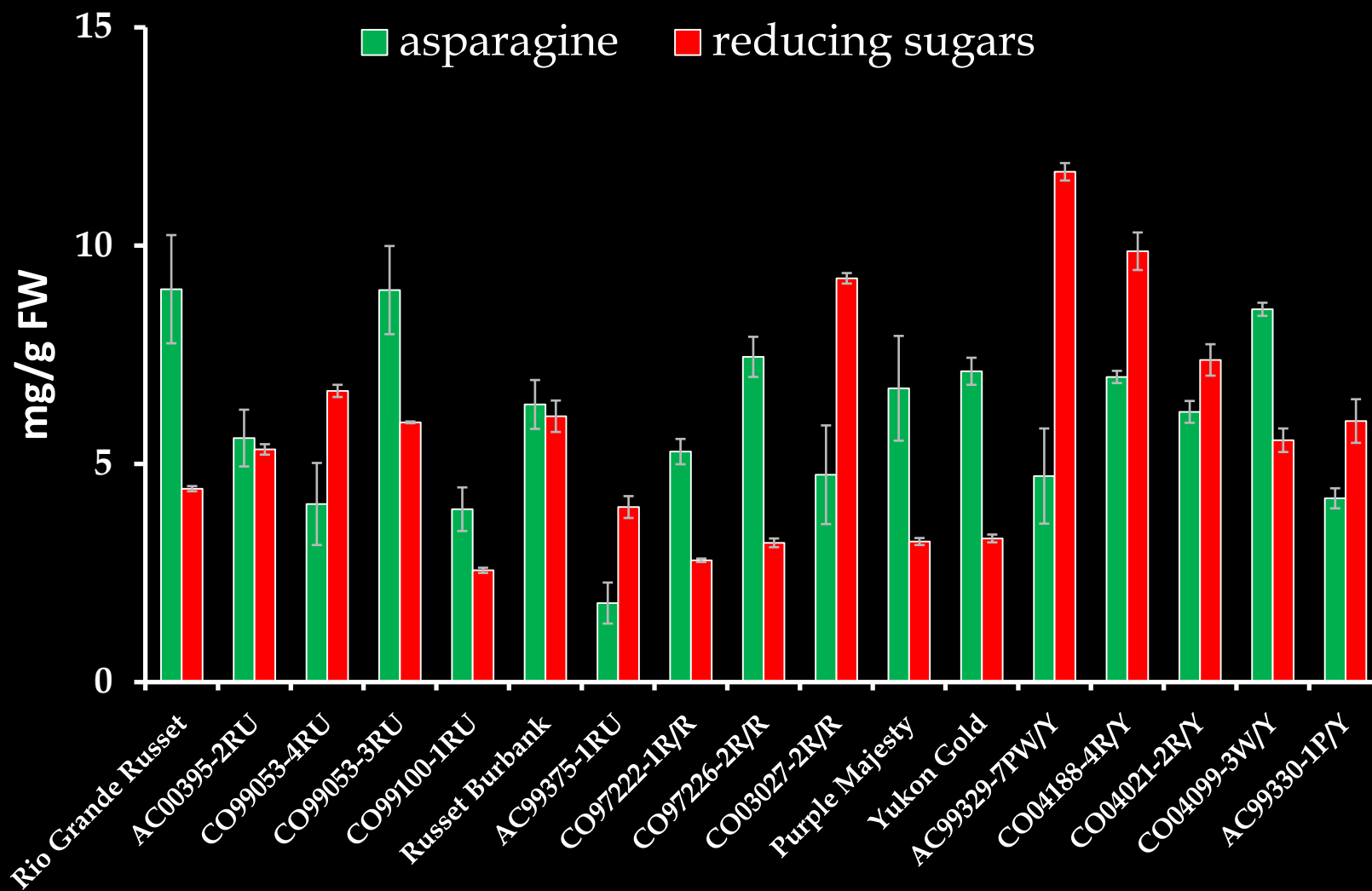
Antioxidant capacity per serving

Food	Serving Size	TAC/serving (μ mol of TE)	
		ORAC	ABTS
Pomegranate	30 ml	21270	7743
Blueberries	(40 g)	19345	5170
Purple Majesty	173 g	13886	3946
CO97226-2R/R	173 g	5066	3559

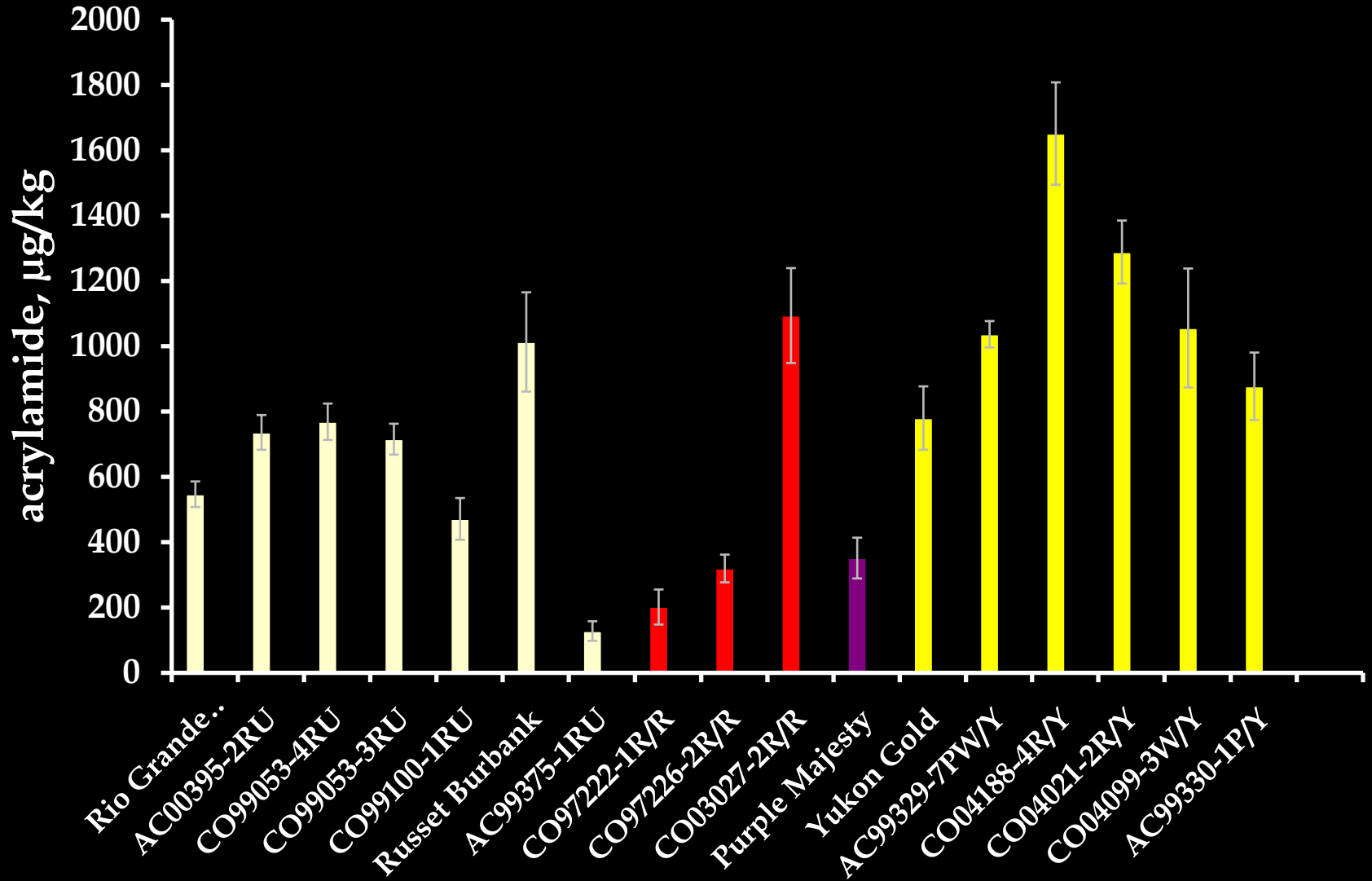
❖ Red and purple fleshed potato tubers had higher levels of total phenolics than the yellow and white tubers

❖ Red and purple fleshed potato tubers had comparable levels of antioxidant activity with blueberries and pomegranate

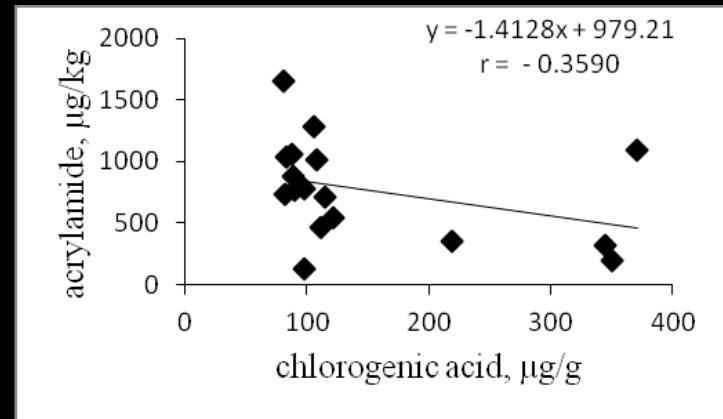
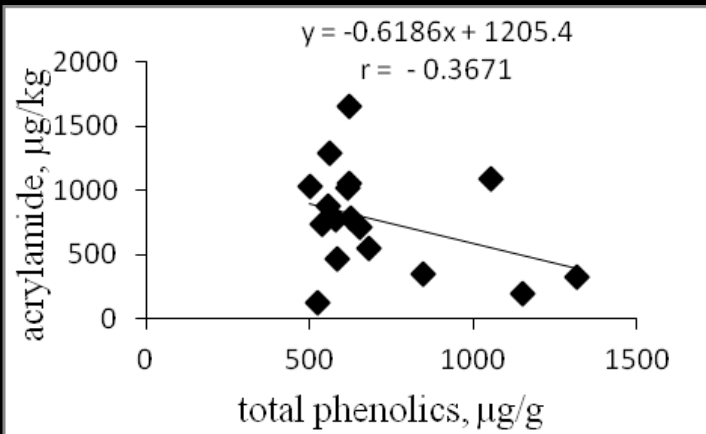
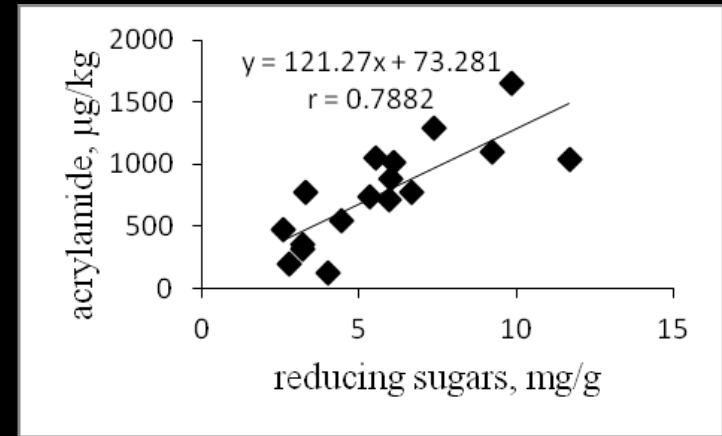
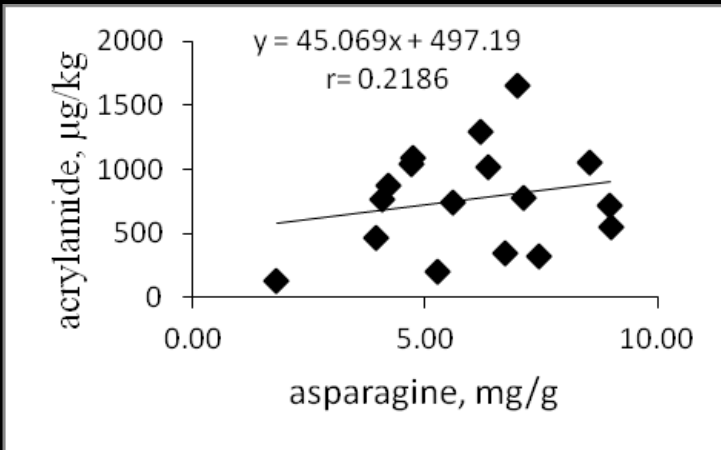
Asparagine and reducing sugars in potato tubers



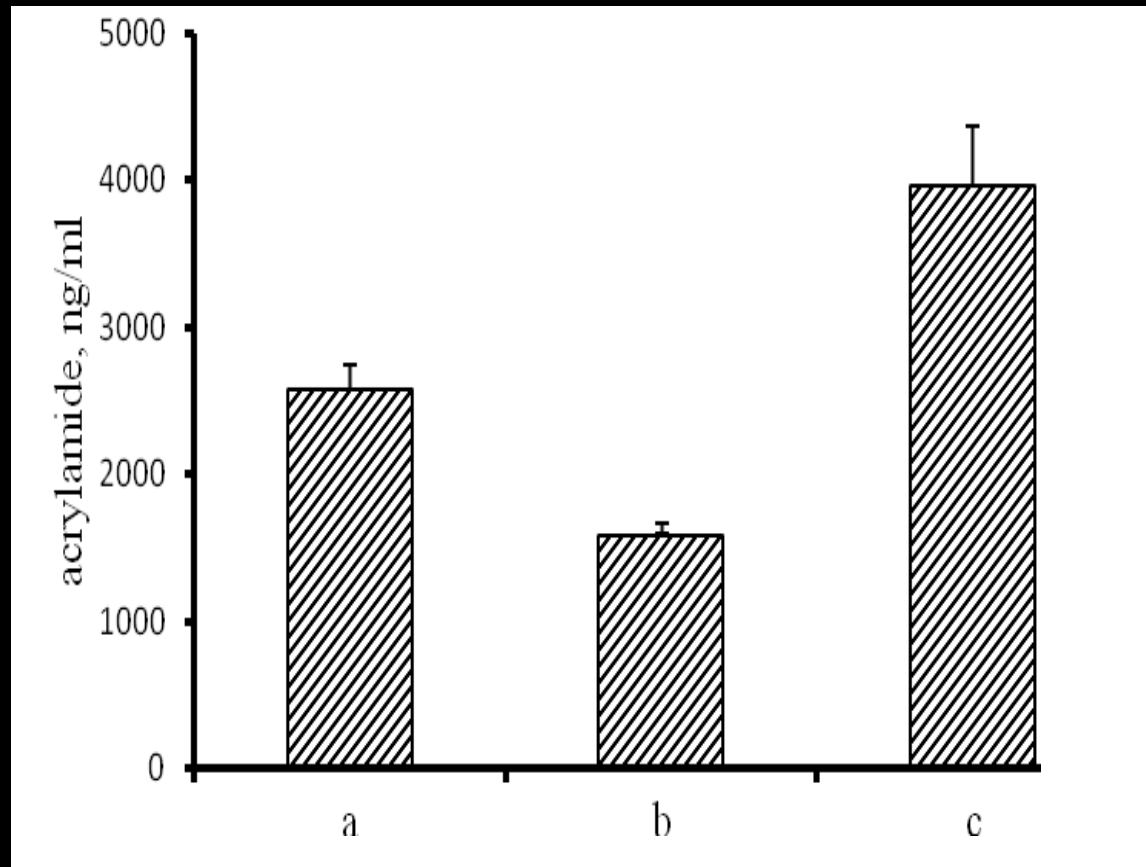
Acrylamide in French fries



Correlation of acrylamide with asparagine, reducing sugars, and phenolics



Effect of chlorogenic acid



Asparagine : glucose : chlorogenic acid

a) 1 : 1 : 0

b) 1 : 1 : 1

c) 1 : 5 : 1

Conclusions

- ❖ Red and purple fleshed potato tubers had higher levels of total phenolics than the yellow and white tubers
- ❖ Red and purple fleshed potato tubers had comparable levels of antioxidant activity with blueberries and pomegranate
- ❖ Potato tubers with lower levels asparagine and reducing sugars, and higher levels phenolics form lower levels of acrylamide

Acknowledgement

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