Influence of latitude and altitude on the composition of wild Chinese sea buckthorn (*Hippophaë rhamnoides* ssp. *sinensis*)

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## **Brief introduction**

- Wild Chinese sea buckthorn
  - Hippophaë rhamnoides ssp. sinensis
- Resistance to extreme conditions
- Widely spread in China
- Chinese traditional medicine
- Health benefits of sea buckthorn
  - Antioxidant activity
  - skin, mucosa, eyes, cardiovascular system, sugar metabolism
- Food and food ingredients





# Study design

- Results from previous study
  - Genotype, geography, climatic conditions, as well as harvesting time affect internal quality of berries.
- Correlation between climate and latitude/altitude
- Latitude/altitude vs.
   compositional/quality factors
- Sugars and acids
  - sensory properties
  - consumer acceptance





## Materials and methods

Shiguanhe

- Nine natural growth sites in China
  - Longitude:  $101^{\circ} 127^{\circ} E$
  - Latitude: 31° 47° N
  - Altitudes: 210 3115 m
- Two to four field blocks in each location
- Berries harvested in 2006-2008
- Quadruplicate analysis of berry juice with gas chromatography





## Analytes

- Sugars
  - Fructose, glucose, sucrose and ethyl  $\,\beta$  -D-glucopyranoside
- Sugar alcohols
  - L-Quebrachitol, methyl-*myo*-inositol and *myo*-inositol
- Acids
  - Malic acid, citric acid and quinic acid
- Vitamin C
  - In the form of ascorbic acid
- Other parameters



Total sugar, total acid, sugar/acid, sugar/°Brix, soluble solids, pH, juice yield, berry weight



## Results







### PCA bi-plot of sea buckthorn berries from different growth areas





# Correlations between spatial parameters and quality parameters



HL, Heilongjiang; HB, Hebei; IM, Inner Mongolia; SX, Shanxi; SC, Sichuan; QH, Qinghai.



Correlations between spatial parameters and quality parameters

• Bivariate correlation analysis showed latitude and altitude had opposite effects on the composition of the berries.



• malic acid	• ascorbic acid,	negatively	latitude
<ul> <li>citric acid</li> </ul>	<ul> <li>juice yield</li> </ul>	<i>p</i> < 0.01	
<ul> <li>total acid</li> </ul>		positively	altitude



#### No significant differences found (p > 0.05) in

- ascorbic acid
- pH
- juice yield

- □ Sichuan-2000m
- Sichuan-2500m
- □ Sichuan-3000m

\*Results of each component marked with different letters are significantly different (p < 0.05).



### Altitude vs. Composition — Shanxi area

- Significant differences between berries from different altitudes only found in
  - quinic acid
  - myo-inositol
- No clear difference in most of the parameters



\* P < 0.05



## Discussion



- Latitudes/altitudes complex effects of growth environments
  - soil conditions
  - climatic conditions
  - interaction between the genetic and the environmental factors
- Light intensity, photoperiod, and temperature
  - strongly influence the metabolism and concentration of metabolites in plants and fruits
  - respond markedly to variation in latitude and altitude
- Water supply and air humidity are also important factors affecting the composition of sugars and acids in berries and fruits



## Summary



- The composition and content of sugars, sugar alcohols, fruit acids and ascorbic acid vary greatly with growth locations.
- The changes in the berry composition were oppositely associated with the variation in latitudes and altitudes.
- The influence of latitude and altitude on berry composition may be explained by combinations of complex environmental factors.
- The study provides useful guidelines for berry breeding and cultivation as well as industrial utilization of sea buckthorn.



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