Metabolic profiling of sea buckthorn berry based on targeted HPLC and untargeted NMR analyses

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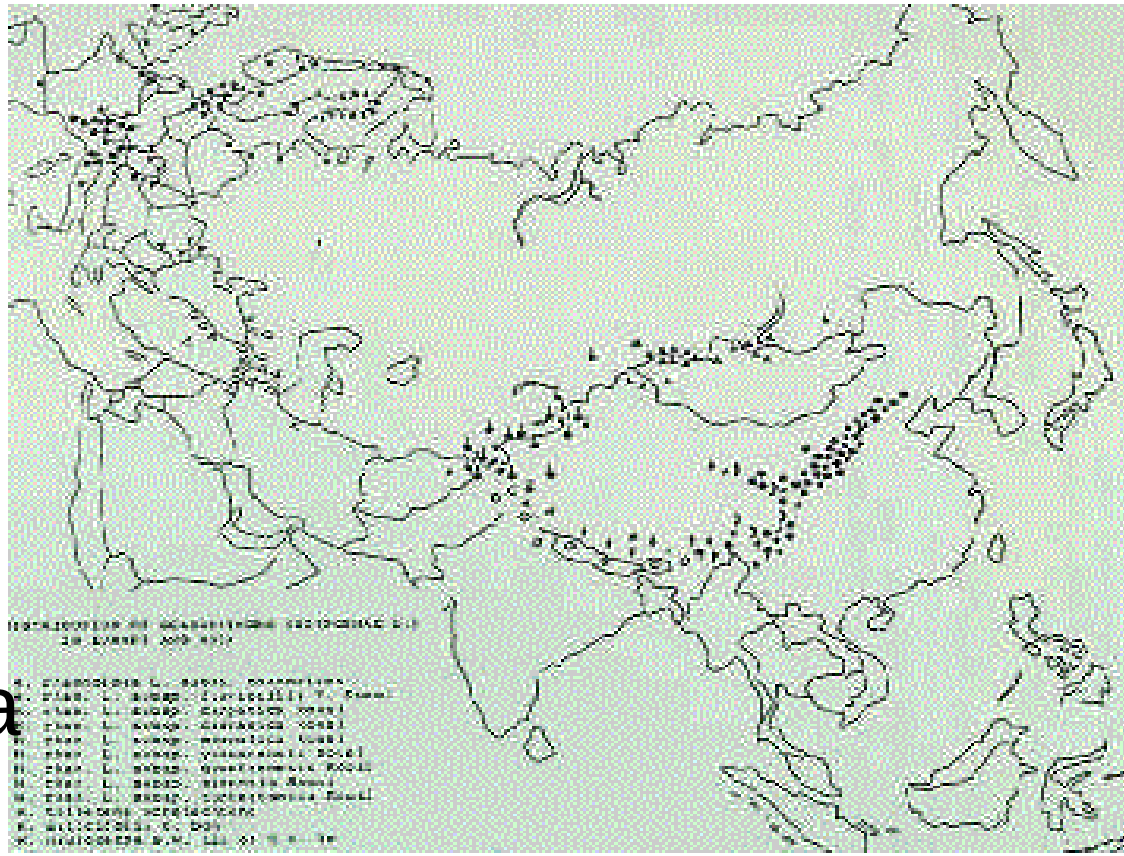
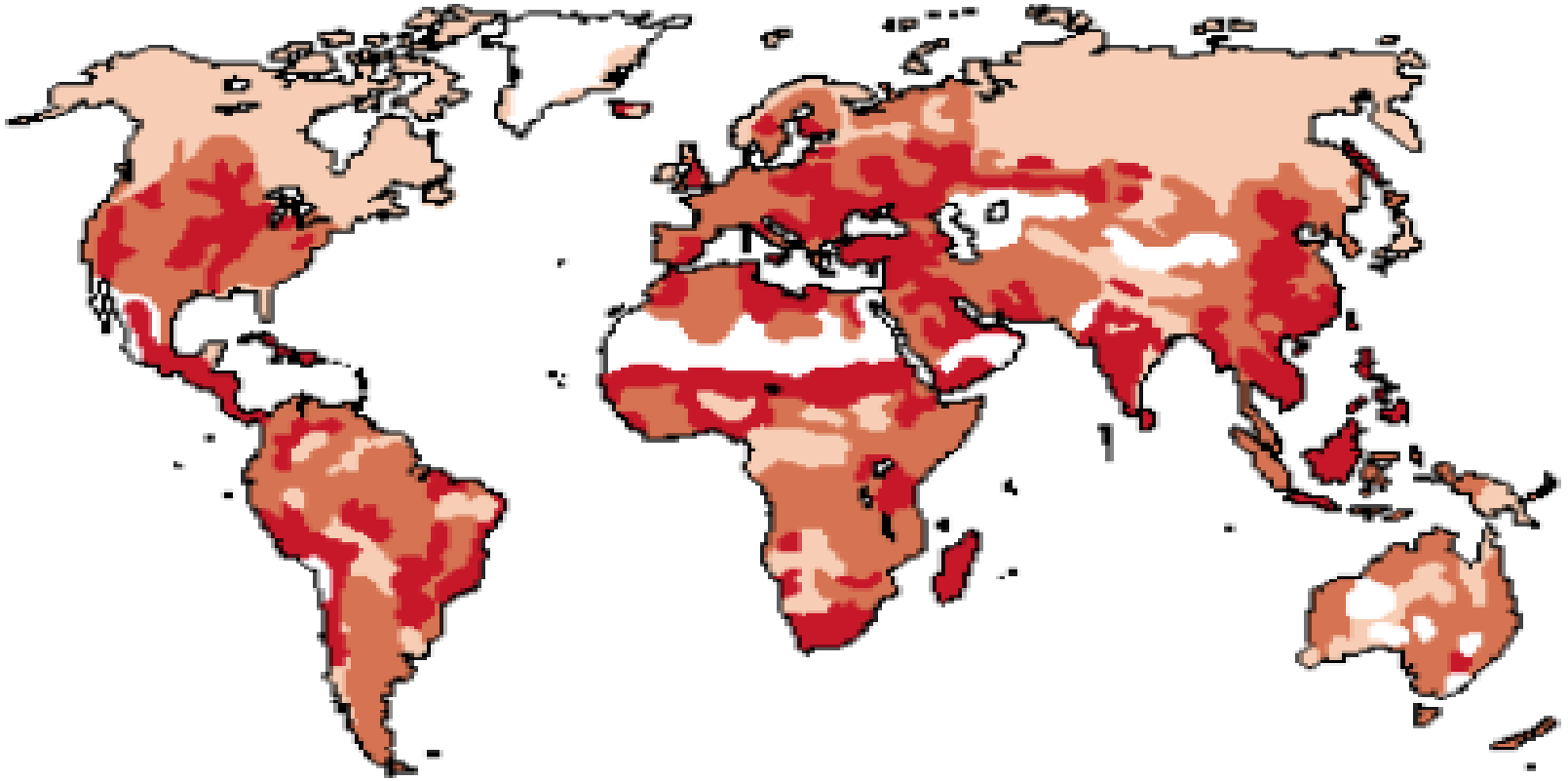
Sea buckthorn in China

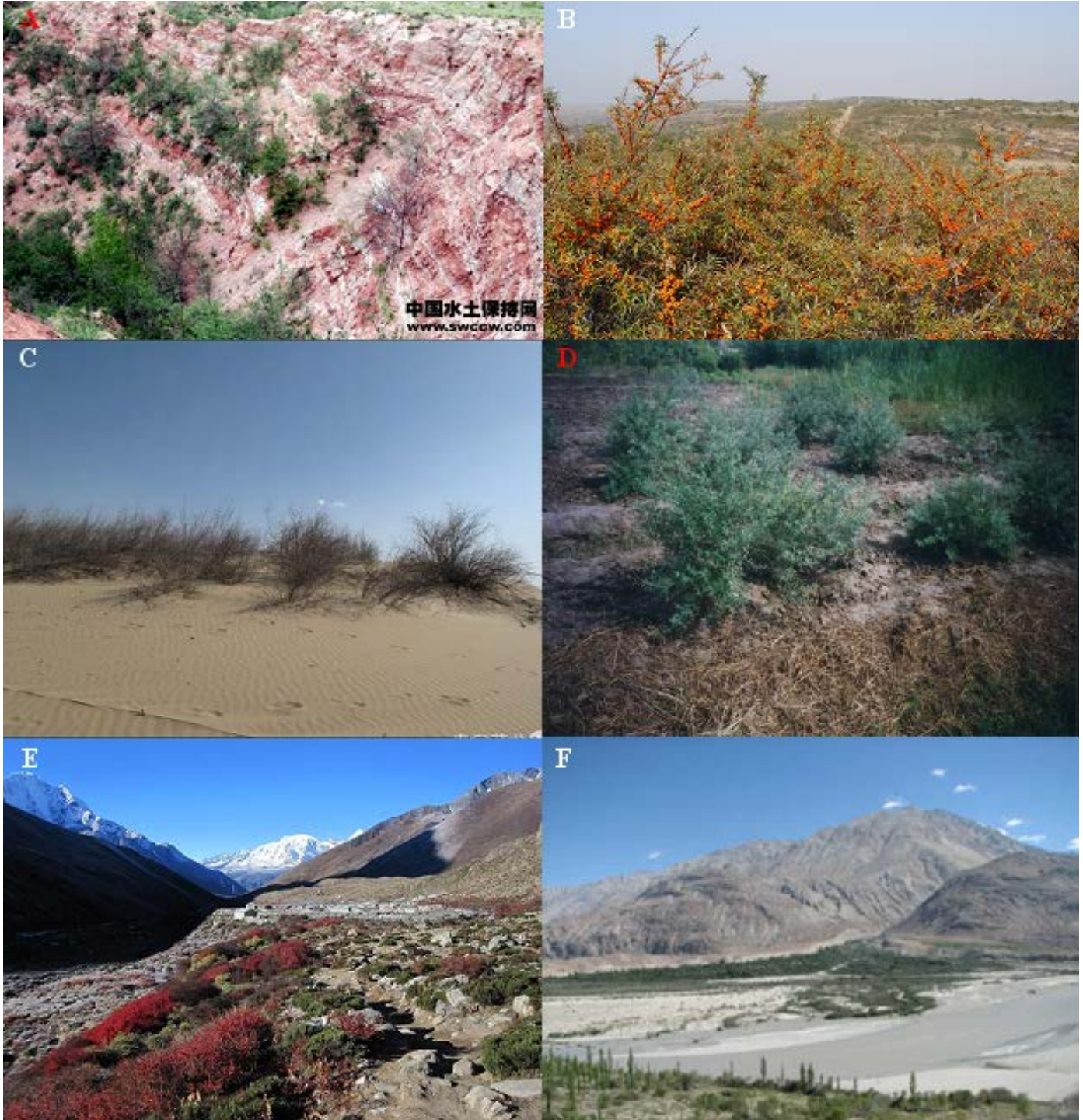
- Total area: 170000 ha (85000 ha is artificial forest).
- New sea buckthorn garden or forest is about 6000 ha per year.



Aims of sea buckthorn populations

- Eco-environmental protection: soil and water conservation, protest for desert, improvement of degraded eco-system.




A
中国水土保持网
www.swcow.com
B
C
D
E
F

Sea buckthorn utilization for human nutrition and health

- Food, nutrition and medicine: The berries are highly appreciated for their unique taste but are also very rich in bioactive compounds with powerful nutritional and medicinal values.


沙棘酒
SHAJI
SHAJI
清妍
BEAUTY
金果
耐福
LIFE
沙棘精油

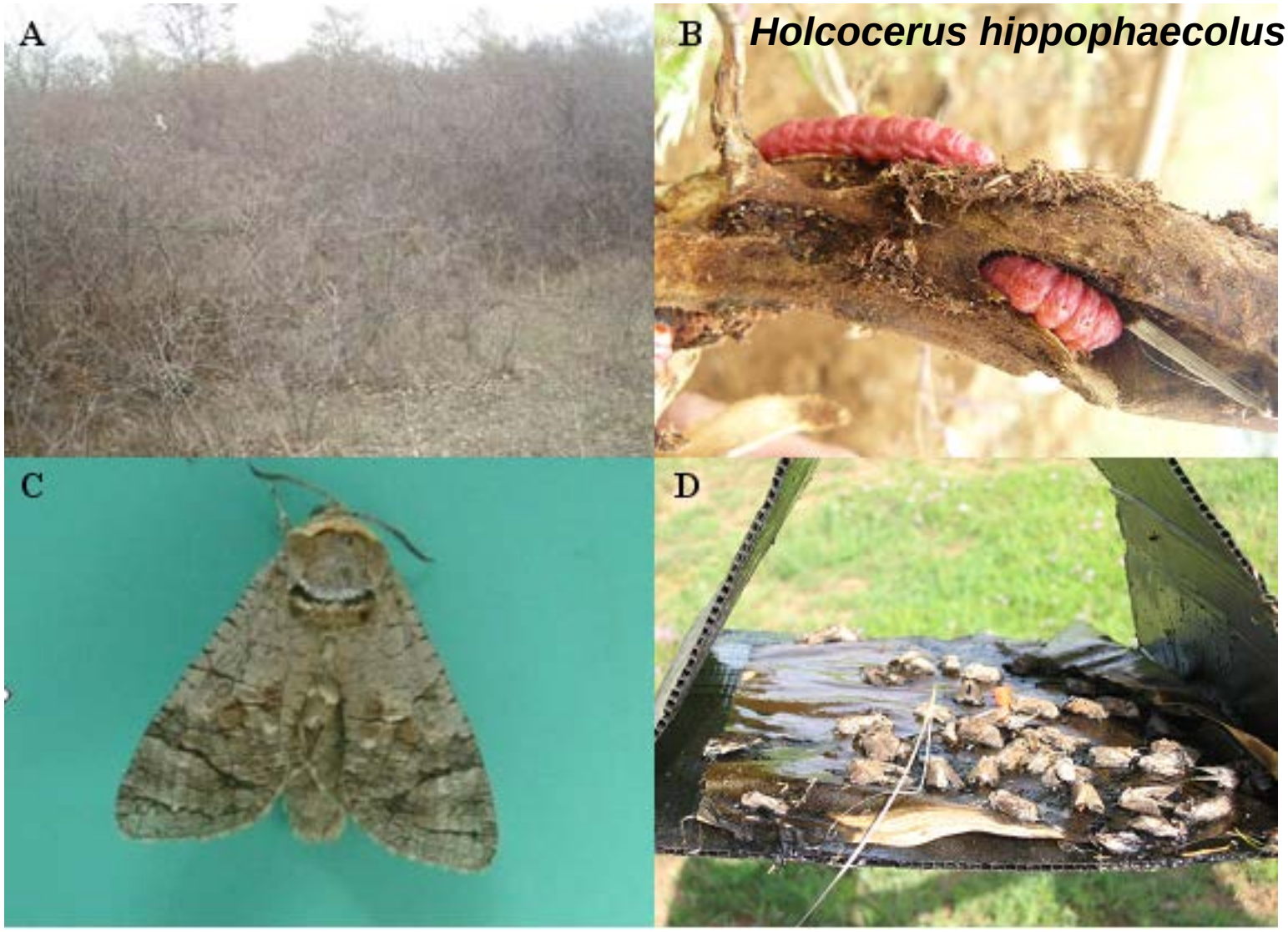
Problems of sea buckthorn in China

- Serious problems have been encountered due to drought, salinity, diseases and insect pests.

- E.g.: increasing abiotic (e.g. drought and salinity) and biotic stress (DSD and insect pests) results in wide-spread plant death over large areas (about 40,000 ha of sea buckthorn, planted in the 1980s, have died in the Jianping county of China alone) and obviously decrease fruit yield.

Pathogens of dried shrink disease

Fusarium oxysporum


A
B
Holcocerus hippophaecolus
C
D

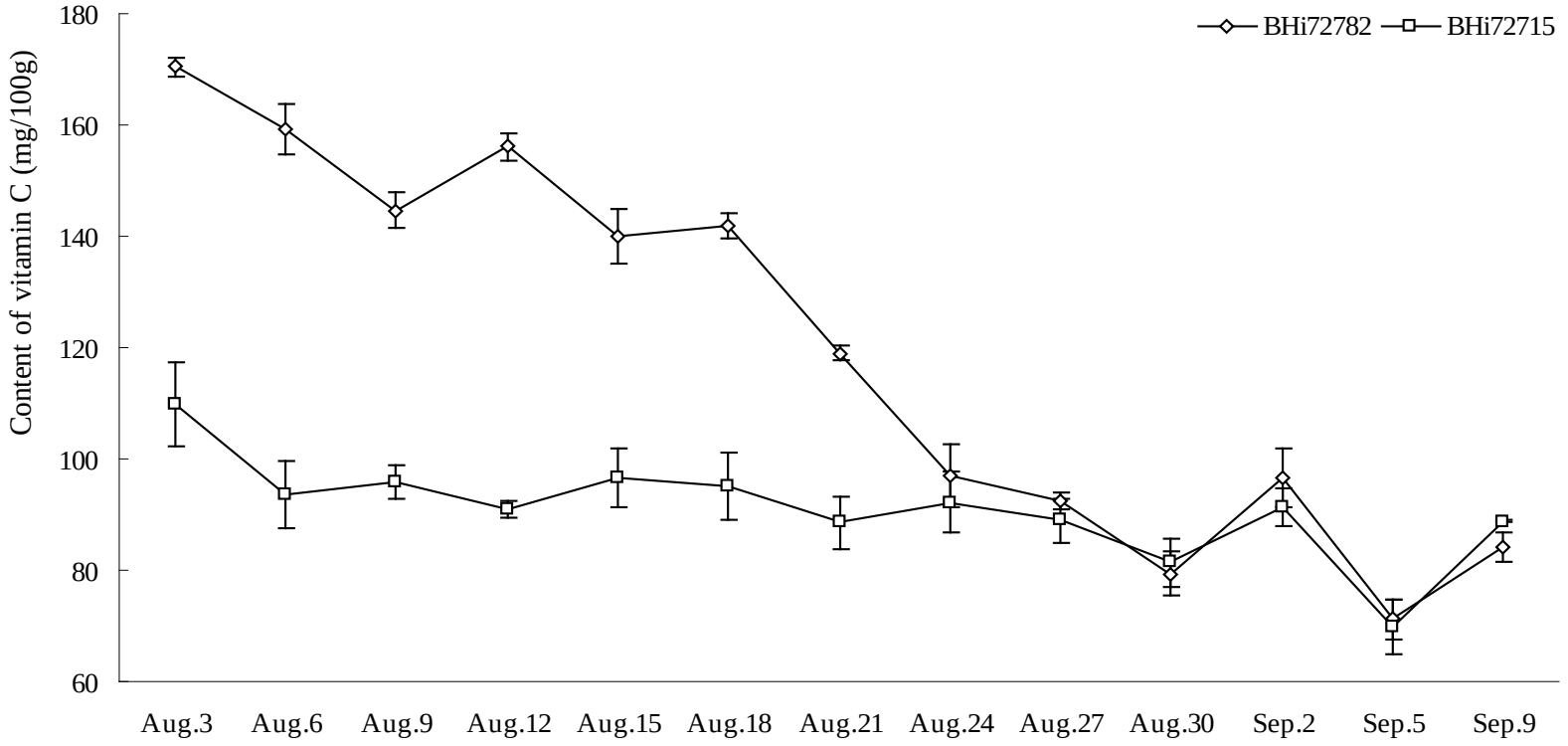
Improvement of berry quality

- Methods are needed for identification of germplasm and characterization of important traits like content of bioactive compounds, level of resistance to abiotic and biotic stress, and optimal harvesting.

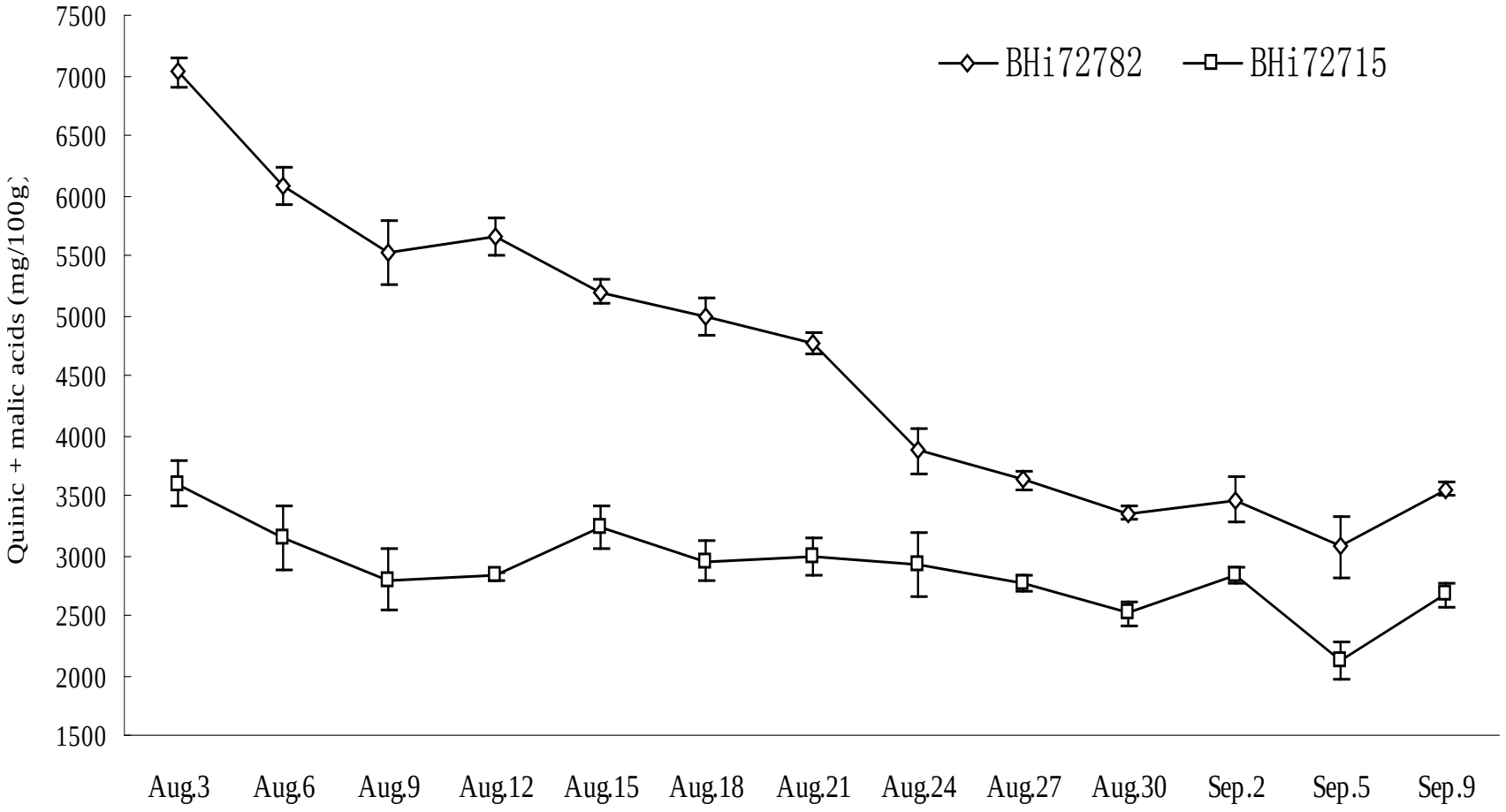
- Selection and breeding for oil content in berry pulp and seeds.

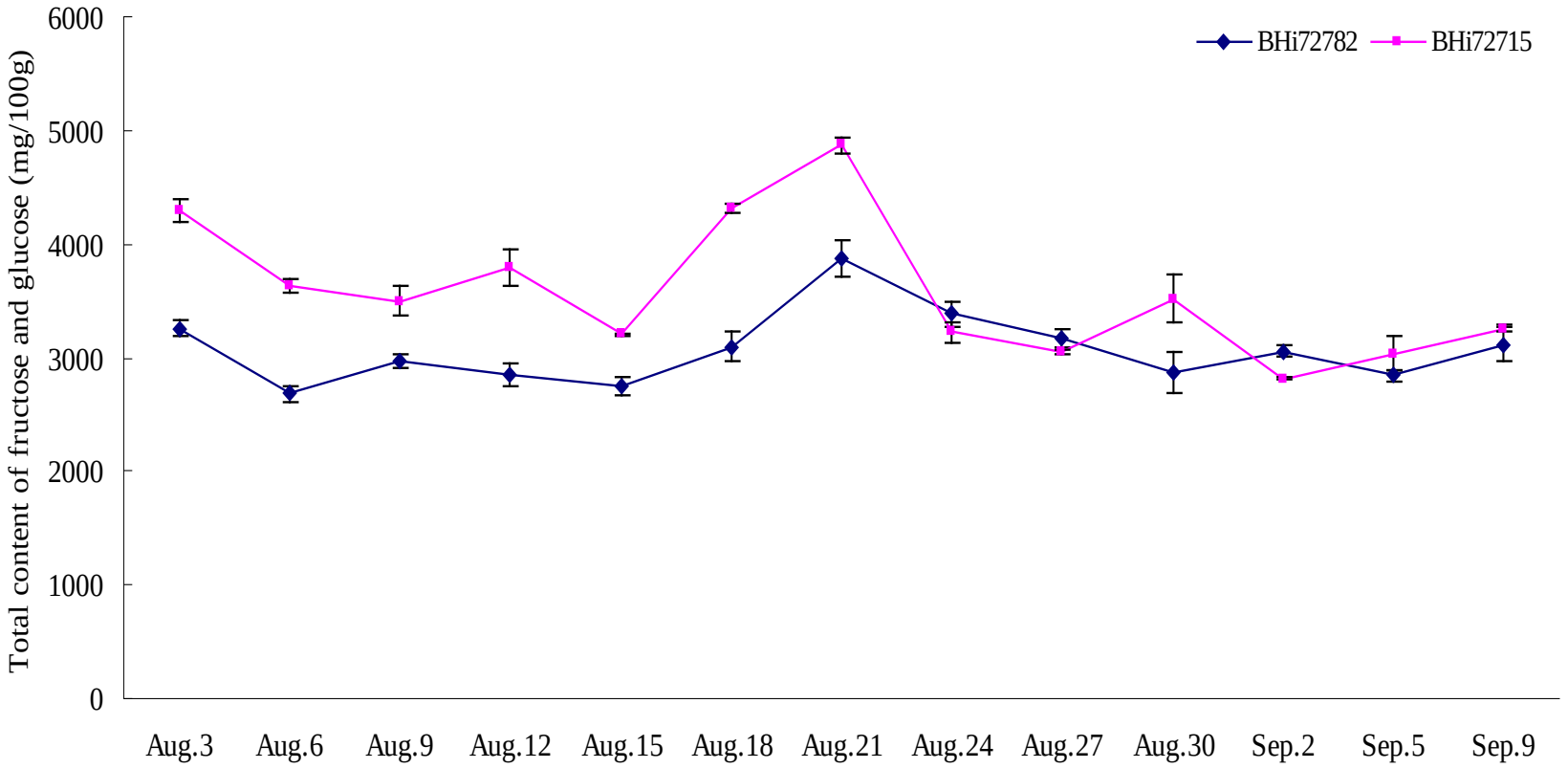
Metabolites in berry pulp display considerable variation during berry ripening

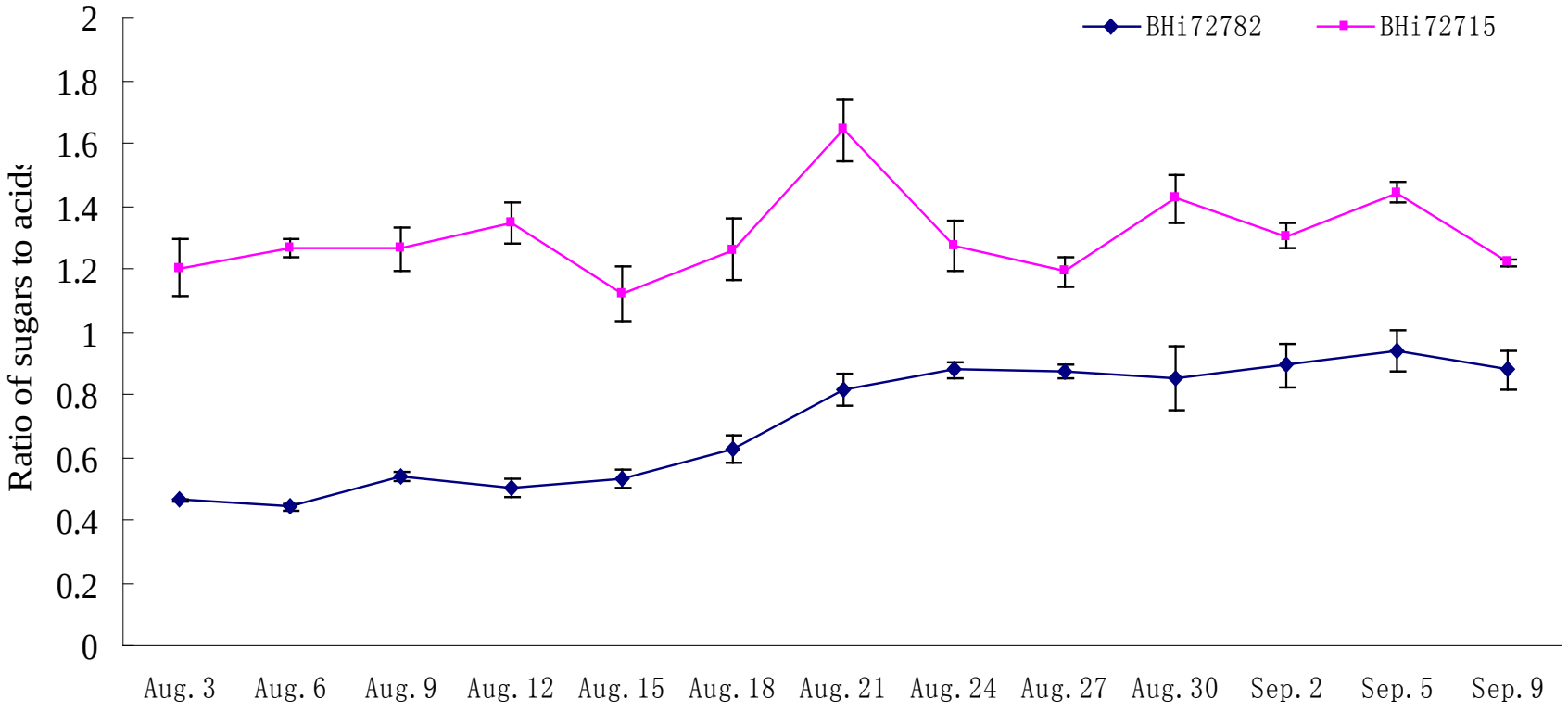
- Metabolite contents in berry pulp display considerable variation during berry ripening, such as vitamin C, quinic and malic acids, sugars, ursolic and oleanolic acids, and polyphenols, based on targeted HPLC analysis.



For BHi72782, vitamin C contents in fresh berry during berry ripening decreases significantly, whereas it is almost stable for cultivar BHi72715.


BHi72782
BHi72715
Quinic + malic acids (mg/100g)
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
Aug.3
Aug.6
Aug.9
Aug.12
Aug.15
Aug.18
Aug.21
Aug.24
Aug.27
Aug.30
Sep.2
Sep.5
Sep.9


BHi72782
BHi72715
Total content of fructose and glucose (mg/100g)
6000
5000
4000
3000
2000
1000
0
Aug.3
Aug.6
Aug.9
Aug.12
Aug.15
Aug.18
Aug.21
Aug.24
Aug.27
Aug.30
Sep.2
Sep.5
Sep.9

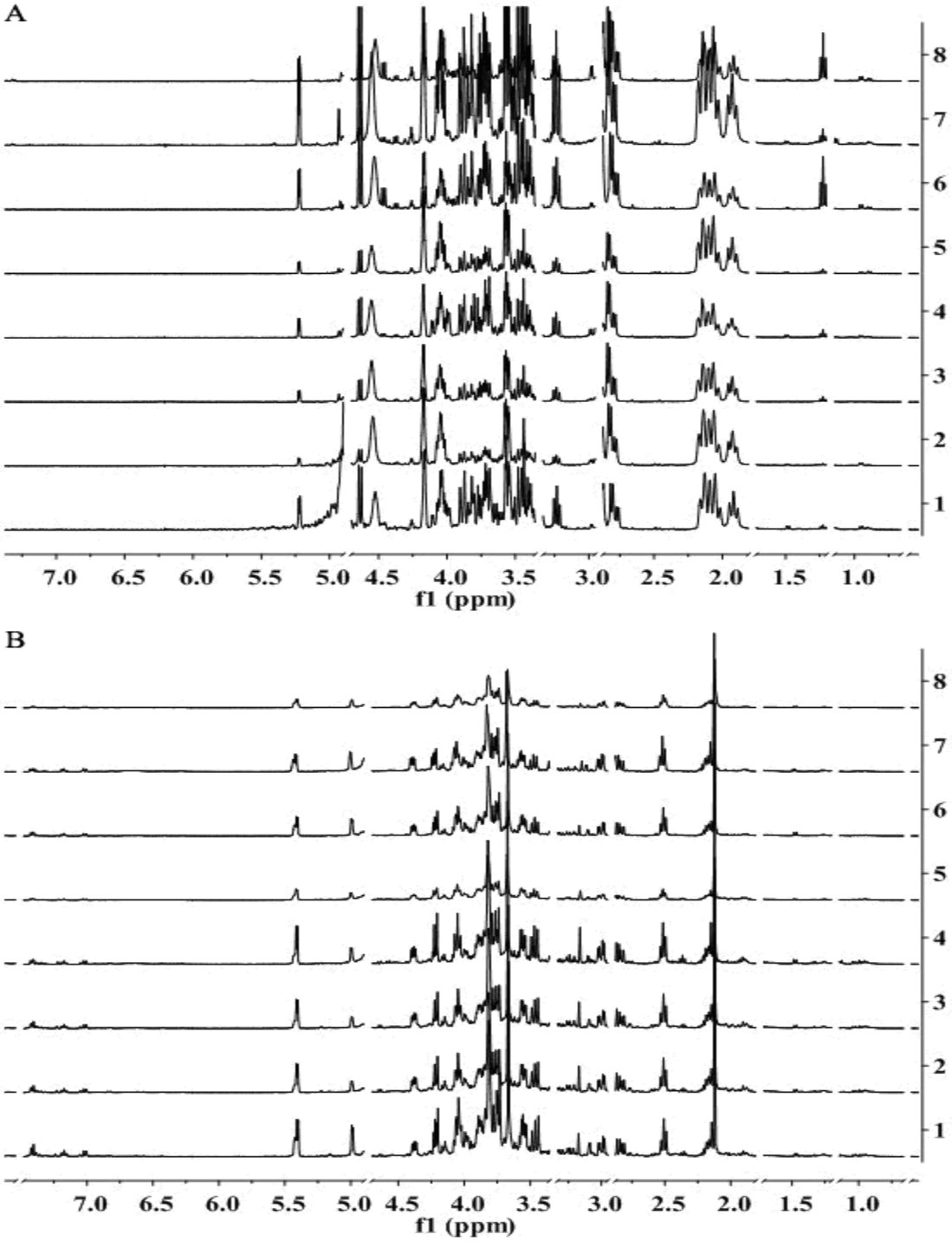


- Cultivar BHi72782 showed steadily increasing sugar/acid ratios during berry ripening, while cultivar BHi72715 showed more variable ratios but without a defined trend.

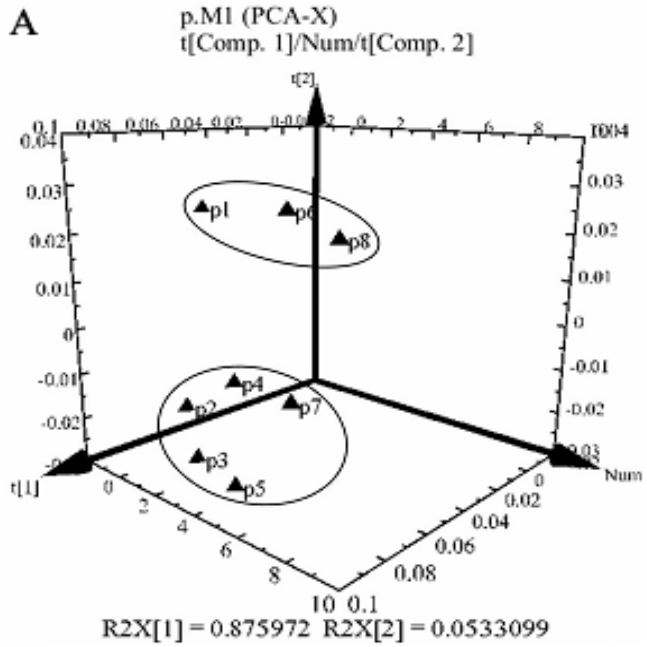
NMR metabolomics of berry quality in sea buckthorn

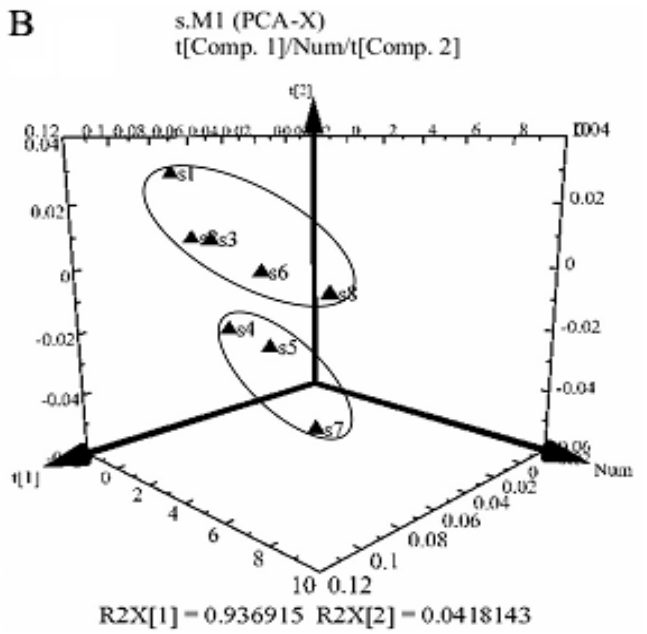
- **Untargeted 1H NMR and principal component analysis (PCA) were used to characterize metabolic profile of sea buckthorn berry quality.**

1. Differences in metabolites between pulp and seeds;
2. Identification of possible biomarkers for distinguishing various sea buckthorn cultivars, and for prediction of berry quality traits;
3. Discuss the potential application of metabolic profiles in pre-breeding, breeding and identification of sea buckthorn germplasm collections.

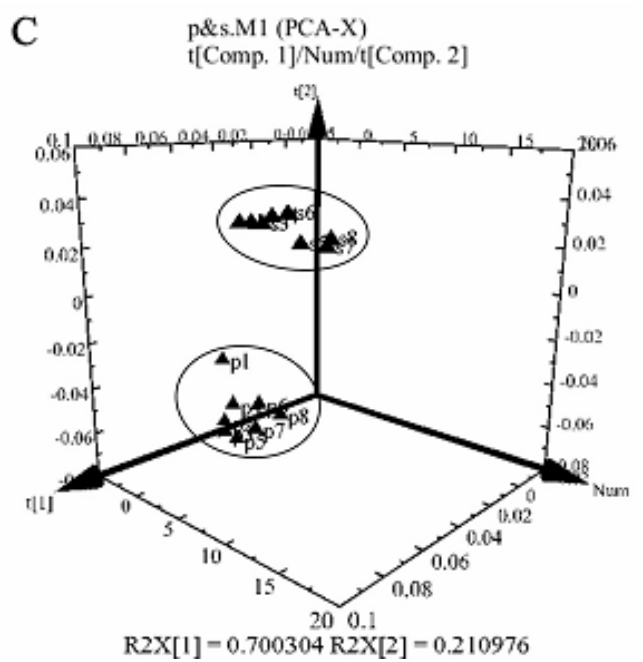


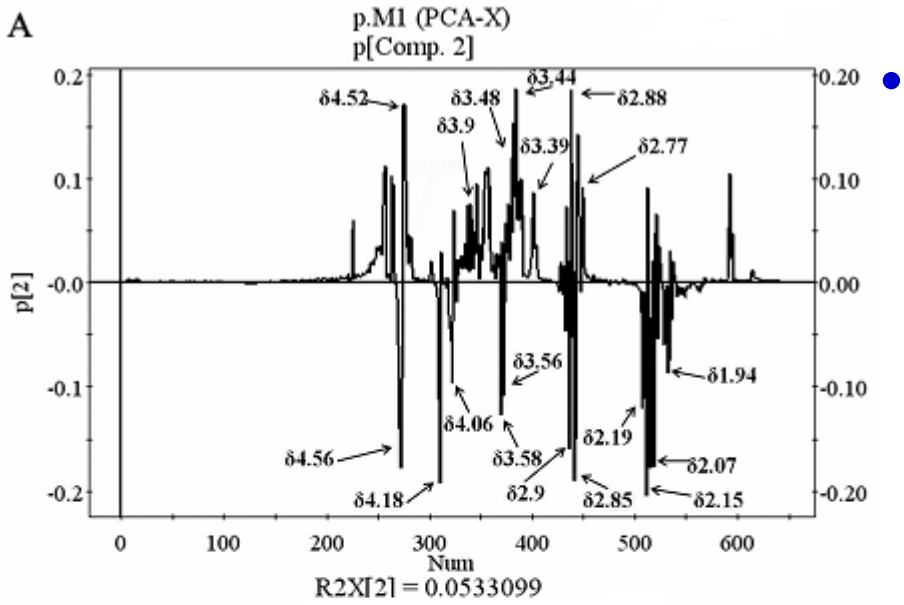
- **The 1H NMR spectra for the aqueous fractions from berry pulp (A) and seeds (B) of eight sea buckthorn cultivars**

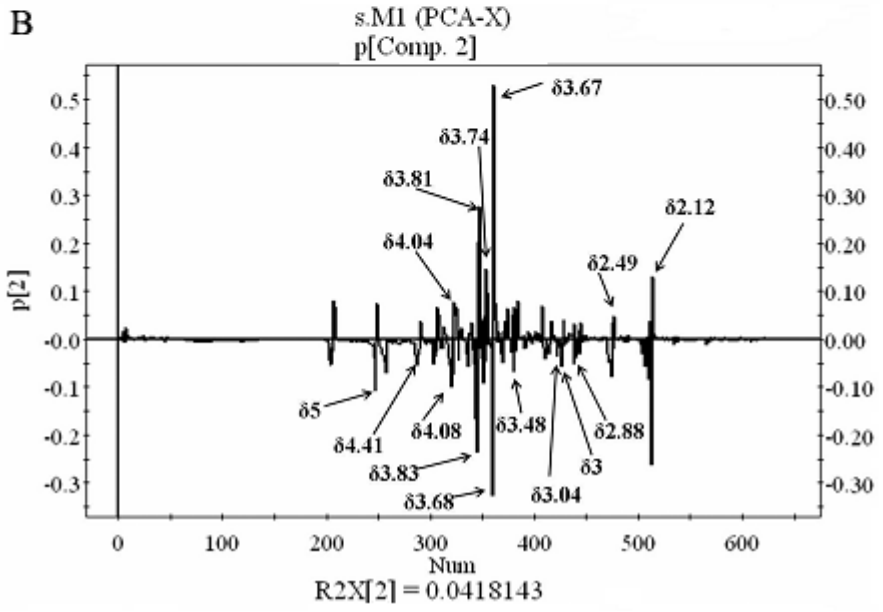


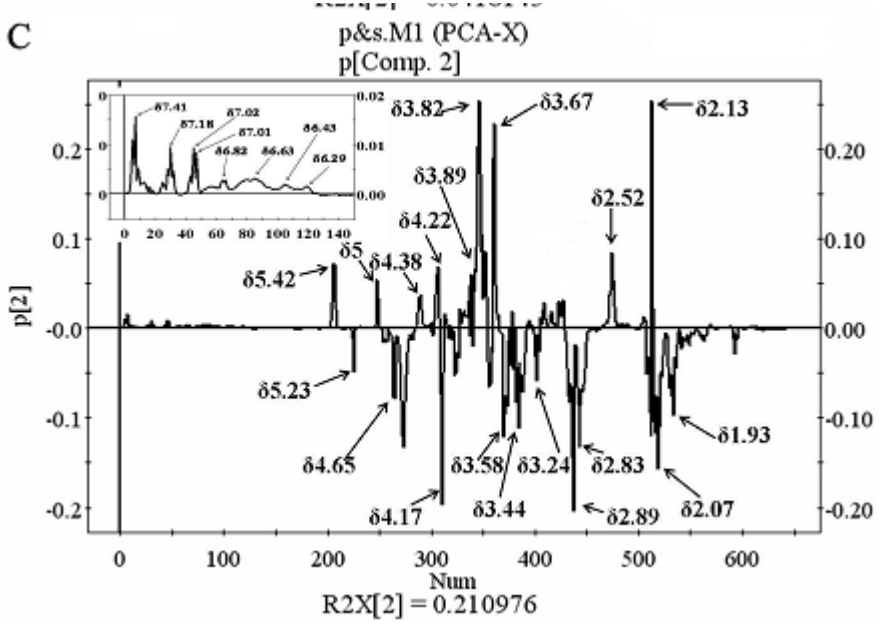


The scores plots of PCA analyses based on 643 buckets of the 1H NMR spectra ranging from δ0.66 to δ7.48 of berry pulp extracts (A), seeds extracts (B) and their combination (C).









- The corresponding loading plots of PC2 in PCA analyses of the 1H NMR spectra for sea buckthorn berry pulp (A), seed extracts (B) and their combination (C)

- There was a strong separation in the NMR signal intensity of bioactive compounds between pulp and seeds, such as amino acids (GABA, aspartate, glutamate, theanine and proline), organic acids (citrate, succinate, malate, acetate, quinate and heriguard) and carbohydrates (sucrose, fructose, glucose and melibiose).
- Sea buckthorn cultivars could be clearly separated into two groups using PCA based on the NMR spectroscopy of bioactive compounds in the pulp and seeds.
- Several metabolic compounds like sugar, organic acids, and amino acids could serve as biomarkers for prediction of berry quality and for classification of germplasm collections.

- This dataset provides potential information concerning the mechanisms of berry quality formation and contributes to increasing the breeding efficiency of sea buckthorn quality improvement.

Thank you for your attention