Supplementary materials for

Optimization of green deep eutectic solvent (DES) extraction of *Chenopodium quinoa* willd. husks saponins by response surface methodology and their antioxidant activities

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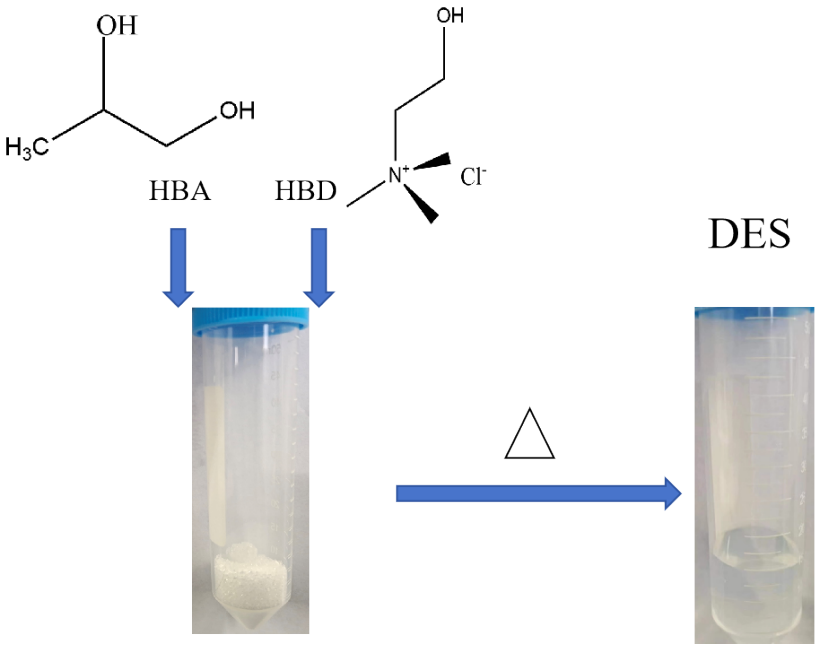

Fig. S1. DES preparation process

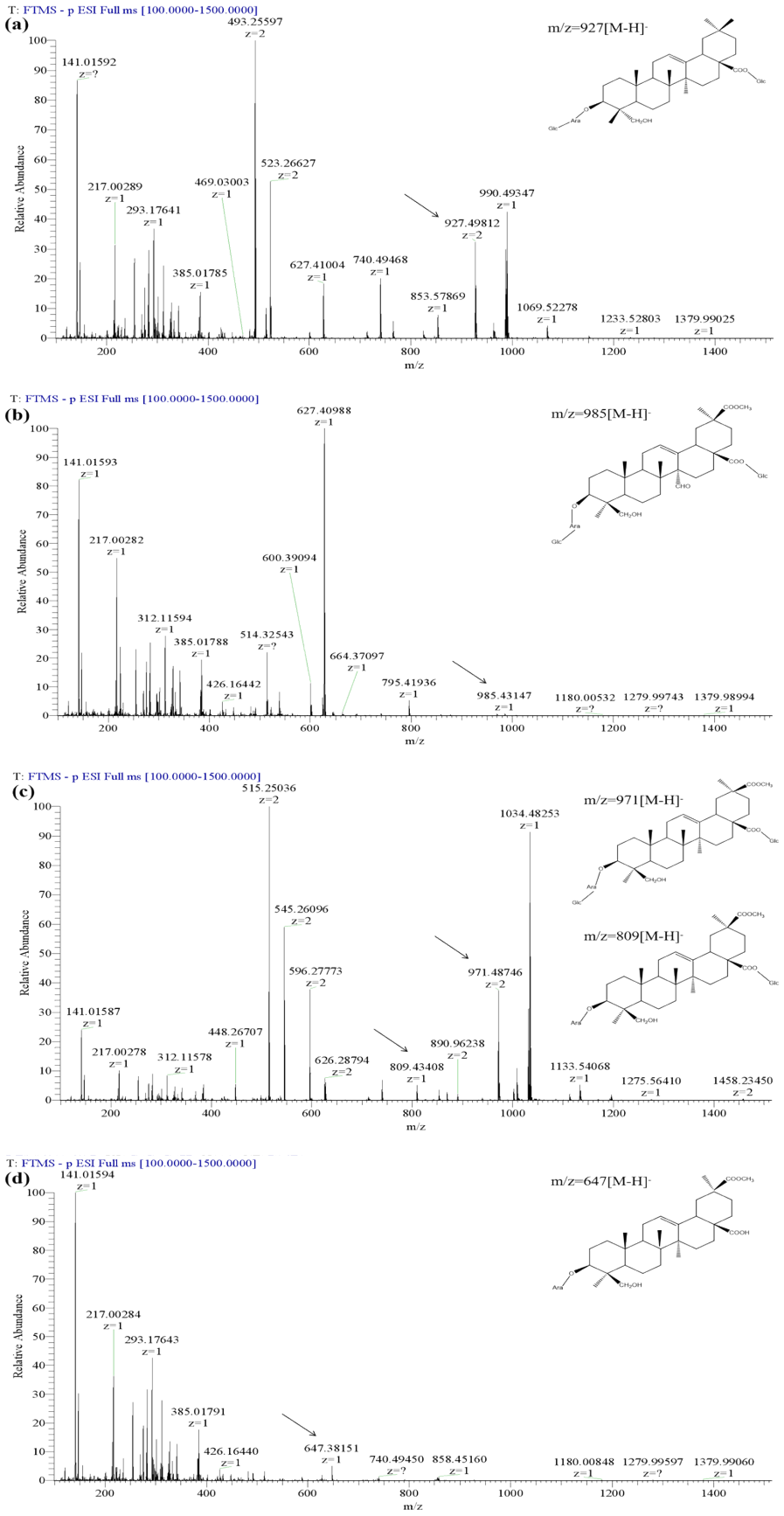

Fig. S2. Major saponin fragment ion peaks of DES extract: fragment ion peak of m/z = 927 (a), m/z = 985 (b), m/z = 971(c), m/z = 809(c) and m/z = 647(d)

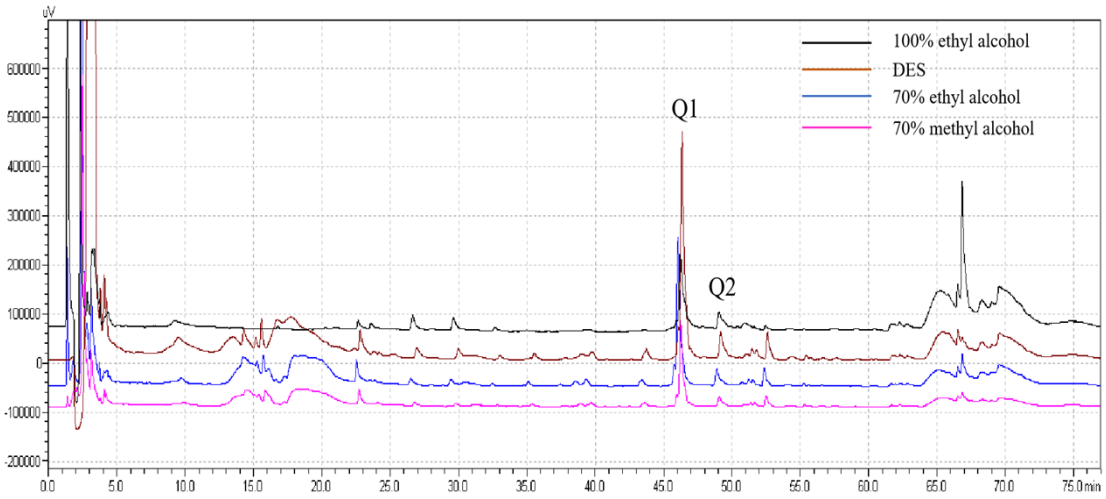

Fig. S3. Comparison of HPLC of quinoa saponins extracted by different extraction solvents

Table S1. MS information of major saponins in DES extracts

No.	Negative ion mode $[M-H]^-$	Compound	Formula	Retention time（min）	Type
1	927	3-O-β-D-glucopyranosyl-(1→3)-α-L-arabinopyranosyl hederagenin-28-O-β-D-glucopyranosyl	$C_{47}H_{76}O_{18}$	17	Hederagenin
2	985	3-O-β-D-glucopyranosyl-(1→3)-α-L-arabinopyranosyl-phytolaccagenic acid-27-oxo-28-O-β-D-glucopyranosyl	$C_{48}H_{74}O_{21}$	13	Hederagenin
3	971	3-O-β-D-glucopyranosyl-(1→3)-α-L-arabino -pyranosyl-phytolaccagenic acid 28-O-β-D-glucopyranosyl	$C_{48}H_{76}O_{20}$	16	Phytolaccagenic acid saponins
4	809	3-O-α-L-arab-inopyranosyl phytolaccagenic acid 28-O-β-D-glucopyranosyl ester	$C_{42}H_{66}O_{15}$	16	Phytolaccagenic acid saponins
5	647	3-O-α-L-arabinopyranosyl-phytolaccagenic acid	$C_{36}H_{56}O_{10}$	18	Phytolaccagenic acid saponins

Table S2. This article compares with other extraction methods

Extract solvents	Extract the substance	Saponins (types)	Activities
DES(choline chloride: 1,2-propylene glycol)	Quinoa Chenopodium quinoa willd. husks	5	Antioxidant activity
DES (choline chloride and glycerol) [15]	Quinoa seeds	11	——
Ethanol [9]	Chenopodium quinoa Wild	4	Foaming and emulsifying characteristics
physical method [5]	Quinoa (Chenopodium quinoa Willd.) Genotypes from Colombia	——	——