????????. ? ???????? ??????????? ????????????? ??????? ?????????, ?????????? ?? ????????????? ?????, ???????????? ????? ?????? ????? ?????? ???????????????????? ????????. ???????? ?? ???????????? ?????????? ?????????????? ?????, ???????????? ????????????? ??????????????????, ???????????????? ????????????? ? ???????????? ???????? ?? ????????????? ????? ?????? ???????? ?????? ?? ?????? ????????. ??-??????, ??? ???????????? ????????? ????? ????????? ????????????? ???????????, ??-??????, ? ???? ????????????? ???????? ??????? ?? ????????????? ?????????? (???????? ??????? ????? ?? ?????????? ????????) ? ??????? ??????? ?????????? ?????????????, ?-???????, ????? ??????? ?????????? ?????? ???????????????? ?? ?????????? ?????? ????????????????? ????? ? ?.?. ???? ??? ???? ?????? ??????????????: ???????? ???????, ???????????? ? ????????, ????? ????????? ????????? ?????, ??? ?????????? ?? ???? ????????????? ????????? ?????? ????????. ??????????, ??? ???????? ???????? ???????????? ?????????? ??????????? ?????? ?? ???? ????????? ???????????? ???????? ???????, ???????????, ???????????? ??? ???? ????????????? ???????? ??????? ???????. ????? ?? ???????????? ????????? ? ????????????? ????????? ?? ???????????? ?????? ???????????? ??????? ?????????? ?????????? ? ?? ????????????? – ?????????????, ???????????? ?????????? ???????????? ???????? ??????? ? ?????????????, ? ??????? ???????? ????????.

??? ????????, ????????? ?????? ? ????????????? ?????????? ??????? ? ????????????? ????????????? ????????????? ????? ? ????? ? ???????????????? ????????????? ?????? ??????? ??? ?????????? ??? ??-?? ?????????? ????????????? ??????? ?????????? ????????, ??? ? ????????? ?????????? ??????????? ????????. ?????? ???????? ? ??????????? ????? ?? ????????? ??????????? ????? ??? ? ??? ??????????, ??? ??? ???? ?? ???? ?????? ???????? ????? ??????????, ????????????? ???????? ???????? ????????, ??, ??? ???????, ???????????? ???????? ?? ?? ????????????? [1].

? ????? ????????? ????????? ???????? ? ???? ???????????? ?????????, ?????? ???????????????? ?? ?????????? ??????: ??????????? ?????????? (??, *Solidago Canadensi)* ? ????????? ??????????? (??, *Hera u So wskyi*). ????????? ???? ??????????, ? ??? ????? ? ??, ???????? ????????????? ?????????, ??? ?????? ? ???????????, ?????????? ? ??????????? ?????????? [2, 3, 4], ??????? ????????????????? ????????? ?? ?????? ?? (??????????, ????????, ???????, ??????? ????????, ?????????) [5].

?? ? ?????? ??? ???????????? ???????? ???????? ? ???? ????????????? ??????? ? ??????? [6], ?? ? ???????????? ???????? ??? ???????? ???? ?? ?????. ????????, ??? ??????????? ???????????? ???????? ???????? ? ??????? ?? ?? ?????????? ????????? ????????? ? ????????????? ????????? ? ????????????? ????????????? (????????????) – ????? ???????????????????? ???????????????????? ?????????? ? ??????? ????????? ???? ????????????? ? ?????????? ?????? ???????????? ???? ??????? (??????????? ?????????) ??? ????????? (??????????? ?????????? ? ?????????????)) (????????????, ?????????, ?????????, ???????) [7, 8]. ??? ??? ??????????? ????????????????????? ????????, ??? ??????????? ???? ?????, ???????????????? ??????????? ???? ? ?????, ?? ????????????? ?????????? ???????????? ??? ??????? ????????, ???????? ??????????, ????????, ???????. ???????????? ? ?? ????????????? ????????? ???????????????????, ?-??????????, ?????????????????????? ? ???????????? ???????. ? ???????? ????? ?? ?????? ?? ?????? ????? ????????????? ??? ???????????? ??????????, ???????????? ?? ???????????? ? ??????? ?????????????, ????????, ????????, ?????????????. ??????????? ?????? ??? ????????? ????????? ???????? ??, ??? ?? – ?????? ????????????? ????????, ?????????? ? ???????? ???????? ? ?? ????? ??????????? ? ???????????????? ???????? ? ????????? ?????? ? ???? ??????????? [9]. ???????? ?? ??, ??? ?????? ? ?? ??????? ?????????? ?????? ???????????? ??? ???????????????????, ??????? ? ????????????? ?????????? ?????? ????? ???????? ????????? ?????????, ??? ??????????? ????????????? ?????????? ? ???????? ???????? ????????????? ??????? ?? ?????? ????? ???? ???????????? ????? ?????? ???????? [10]. ???????? ?? ??, ??? ?? ??????????? ???? ? ?? ??????????? ??????????? ???????????? ?? ????? ?????????, ??????? ???????????? [11], ???????????? ????????????? ????? ?? ?????? ?? ? ???????????????? ????????????? ? ?????????? ??????????, ???????????? ??? ????????.

? ????? ???????????? ??????????? ???????? ????????????? ????? ????????? «???????????? ????? ?????? ????????» ??? «???????????» – ????? ????????????? ?????? ??????????????????? ?????? ???????, ??????? ???????????? ? ???? ????? ??? ????????????? ????????????? ????? ? ?????????? ?? ??? ??????. ????? ???????????? ?????, ?????????? ?? ??? ????????????, ???????? ???????? ?????? ???????, ??????????? ? ?????????? ????????? ??? ?? ?????????, ??? ? ?? ???????, ??????? ?????????, ?????? ????????????? ??????? ???????????? ?????, ??? ???????, ????????????? ??????? ??????. ?? ????????? ? ???? ??? ????????????? ??? ???????? ????????????? ????? ? ?????? ??? ????????, ???????? ??????? ? ????? ???????, ??????? ?????? ???????????????, ????? ???????? ?????????? ??? ??????????? ?????????? ? ??????????? ????????????? ??????? ??? ??????????? ????????????? ? ???????????.

????????????? ???????? ?????????? ????????? (???) ????? ???????????????? ???? ? ???????? ????????? ????????????? ???????????, ?? ???? ????????? ??????????? ??????????? ??????????? ???????????????? ????? [12, 13, 14]. ????????????? ????? ???????? ?? ?????????????, ??? ??????????? ?????????? ????????? [15] ????????????? ?????????? ???????? ??? ???????, ??? «?????????? ??????» ???????, ??? ??????????? ???????? ?????????? ??????? ? ? ???????????????? ????????? ????????.

1? ???-??????? ???????? ????????????? ?????????????, ??? ???????, ???????????? ????? ???????? ??????? ???????, ????????? ???????? ? ???? ??????? ???????? ????????? ??????????. ??????? ??? ??????????? ????????? ???????? ?????? ???????????? ???

[13]C-?????????????, ????????? ??? ???????? ???????? ???????????????? ????????? ?? ????????? ????????? ???????????? ???????, ??????? ?????? ???????? ?????????? ????????????? ??????????. ??????? ? ?????? ????????????

????????????? ^{13}C ???, ???????? ????????? ? ??????????? ?????????? [16, 17].

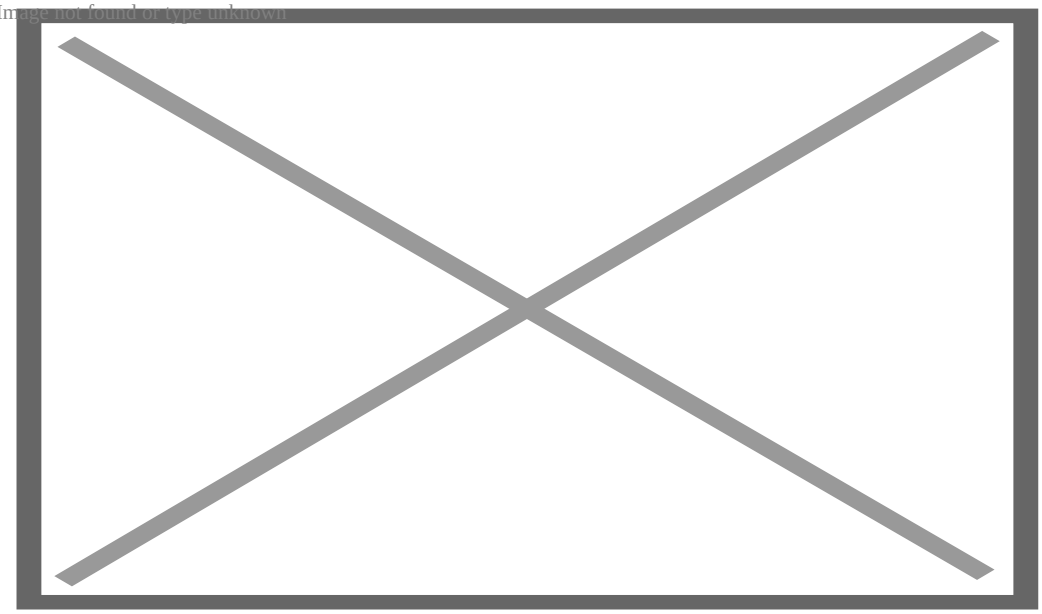
????: ??????????? ??????? ? ????????????????? ????????????? ?????????? ??????????? ?????????? ? ????????? ??????????? ??????? ??? ^{13}? ? ????? ????????????? ? ?????????? ?????????? ?????????? ??? ????????????? ?????, ?????? ??? ????????, ? ????? ??? ????????? ???????????? ???????????? ???????, ???????? ? ?????? ?????? ????????????? ????????.

????????? ? ?????? ????????????. ??????????? ??? ???????????? ????????? ????? ?? ? ?????? ?? ????????? ? ?????????? ??????? ? 2020 ???? ? ????????????????? ???????? ?????????????????? ????????????? ??????? ???? ??. ?.?. ????????. ????? ???????????? ???????????? ????? ? ??????? ??????????? ?? ????????-?????? ????????. ?????????? «?????? ? ????? ??? ???????????» ??? ??????? ?? ????????, ?????????? ? ??? 1.2.1.0010.15. ??? ??????? ???? ???????????? ?????? ? ?????-????????? ?????????? ????? ?? ?????????, ?????????????? ?????????????? ??????????? ?? XIV ???????.

???? ???????????? ?????? ???????? ???????? ?????????? ?????????? ????????? ???? ??????? ????????-13 ???????? ?????? ? ?????-????????? (70%) ?????????? ?????????? ?????. ??????? ??? ^{13}?[^{1}H] ???????? ?????????? ? ????????????? ??????????? ???????? (^{1}?) ???????? ??? ????????? ??????????? (298?) ?? ??????????? ????????????? ????????? [16] ?? ???????????? AVANCE-300 (Bruker, ????????) ?? ?????????????? ????????.

?????????? ???????? ??? ^{13}? ????????????? ? ?????? ?????????????? ?????????? (^{1}?) ????????, ? ?????????? ???? ? ???????? ?-13 ????????? ?????????? ?? ??????????? ??????????? ??-?? ????????? ????-???????? ^{13}?-^{1}? ??????????????, ??? ??????????? ???????? ??????? ?-13 ??? ????????????? ????????. ???????????? ????????? ???? ????????????? ?? ??????? ???????? ??????? ??????? ???? D2O, ??? ???????? ?????????. ??? ?????????? ?????? ?-13 ???????? ?????????? ????????? ???????????? ??????? ???????????????? Si(CH3)$_4$? ?????????? ????? (?.?. ??? ppm) [16, 17].

?????????? ???????????? ? ?? ??????????. ?? ???. 1 ? 2 ????????? ??????? ??? ^{13}? ? ????????????? ??????????? ???????? ??? ??????? ? ?????-?????????? ?????????? ?? ??????????????. ??????? ?-13 ???????????? ????? ?????? ????????, ????????? ?? 30-40 ????? ? ?????????????? ???????? ?????????????? ? ??????????? ????????. ???????? ?????????? ??????? (ppm) ???????? ?-13 ????????? ? ??????? ????? ????????. ????? ???????? ? ???????? ??? ^{13}?[^{1}H] ?????????? ????????????? ???????????????? ???????????? ????????? ???????????? ??????? ? ??????????? ?? ???? ????????????. ????????????? ?????? ???????? ??? ^{13}? ? ????????????? ??????????? ???????? ??????? ? ?????-?????????? ?????????? ??, ??????????? ?? ???. 3, ??????????, ??? ???? ????????? ????? ???????? ? ???? ???????? ????????? ?? ????????? ?????????? ???????. ????? ??? ???????? ????? ???????? ? ???????? ????? ???? ????????????? ???????? ?????????? ??????? ? ??????? ????????????? ? ??????????? ?? ???????????????? ???????????. ????? ??????, ???????? ????? ??????? ?????????? ??????? ??????? ???????? ????????? ?? ??????????? ?????????? ?? ??????? ?????????? ??????? ?????-?????????? ????????? ??.



???. 1. ???????? ?????? ??? ^{13}? ? ????????????? ??????????? ???????? ??????? ????????? ??

Fig. 1. Panoramic ^{13}C NMR spectrum with broadband proton suppression of an aqueous extract of BS

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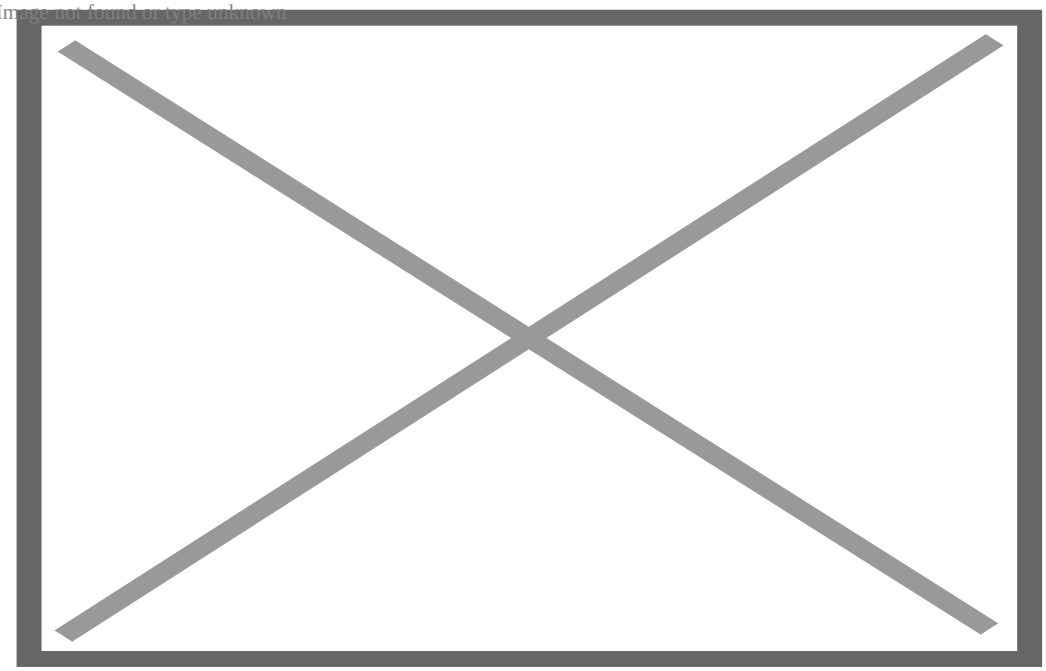
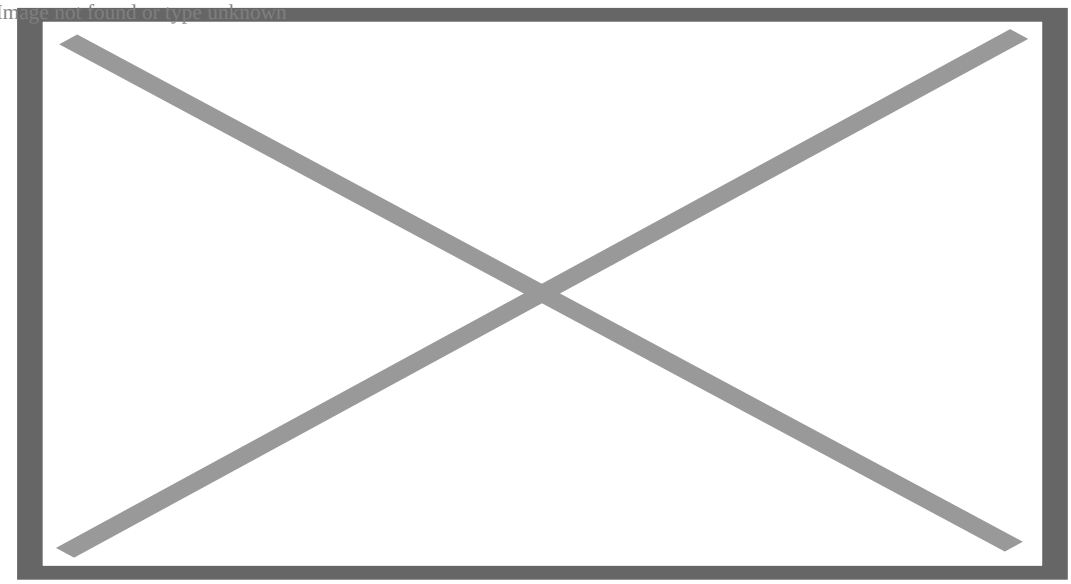


???. 2. ???????? ?????? ??? ^{13}? ? ?????????????? ??????????? ????????
?????-?????????? ????????? ??

Fig. 2. Panoramic ^{13}C NMR spectrum with broadband proton suppression of a hydroalcoholic extract of BS

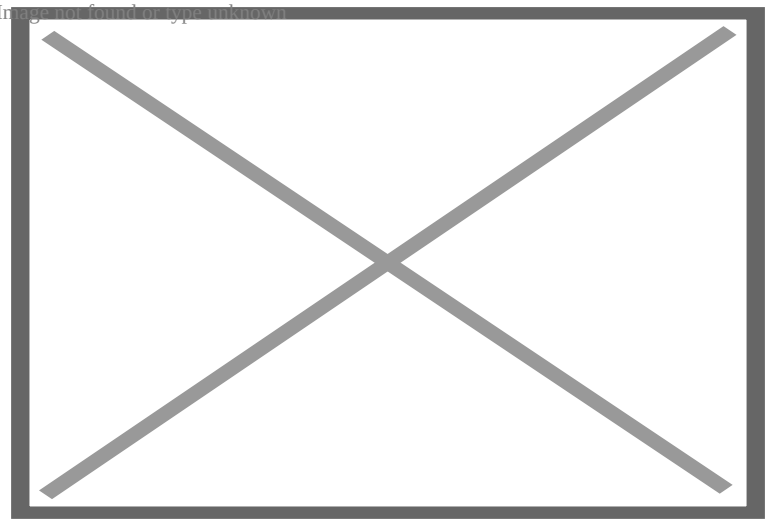
?????? ? ?????-????????? ????????? ?? ???????? ? ????? ??????? ????? ?????? ????????????? ????????????? ????????? ? ?????????????, ? ??? ?????????????? ????????? ?????????? ??????? ???????? ???????? ??? [16, 17] ? ???, ? ???? ???????, ????????? ?????? ?????????? [6, 7, 8, 9, 10, 18] ? ?????????????? ??????????? ?????????? [19].

Image not found or type unknown



???. 3. ???????? ??????? ??? ^{13}? ? ?????????????? ??????????? ????????
??????? ????????? ?? (?????? ??????) ? ?????-?????????? (70 %) ????????? ?? (??????? ??????)
Fig. 3. Panoramic ^{13}C NMR spectra with broadband proton suppression of an aqueous extract of BS (lower spectrum) and a hydroalcoholic (70 %) extract of BS (upper spectrum)

?? ???. 4 ????????? ???????? ??????? ??? ^{13}? ? ?????????????? ??????????? ???????? ??????? ? ?????-????????? ?????????? ???????????. ?????? ?????-?????????? ????????? (????? 60 ????????) ??????????? ?????????? ?? ??????? ??????? ????????? (??????? 45 ????????), ??? ???? ??????? ? ????????, ??? ???????, ?? ????????? ?? ????????? ?????????? ???????, ?.?. ?????????????????? ????????? ???????? ?? ?????? ???????. ????? ???????? ???????? ????? ??? ????????????? ?????????? ?????????? ????????, ??????? ???????????? ?? ???. 5.
???????? ?? ????????, ??? ?????????????? ???? ??????????? ???????? ???????????? ???????????, ??? ??-??????? ????????? ???????? ?? ????????????? ?????. ????, ??????? ?????????????? ????????????, ?? ???????? ?????????? ? ??????????? ??????? ???????????? ???????? ???????????? ?????????,?? ? ?? ?? ????? ????????? ?????????? ???????? ? ????????? ????????????? ?????????????? ?????????. ????? ???????, ??? ????????? ??????????? ?????????? ???????????? ???????? ??????? ?? ????????????? ????? ?? ?????? ??????????? ?????????? ? ????????? ??????????? ? ???????? ??????????? ??????? ???????????? ?????-????????? ?????.



???. 4. ???????? ??????? ??? ^{13}? ? ?????????????? ??????????? ???????? - 1)
?????? ???????? ?? (?????? ??????), 2) ?????-????????? ???????? ?? (??????? ??????).
Fig. 4. Survey 13C NMR spectra with broadband proton suppression - 1) aqueous extract of SC (lower spectrum), 2) hydroalcoholic extract of SC (upper spectrum)

?????????? ?????? ???????? ???????? ??? ??????? ? ?????-?????????? ?????????? ???????????, ???????????? ? ???????????????? ??????? [16, 17], ????????????? ???????????? ??????
[20-22] ? ???????????? ????????????, ?????????? ??????, ????????? ?????????????? ????, ????????????? ????????????? ????????.
????? ???????, ????????? ????? ??????? ?????????????? ???????? ??? ^{13}? ?????-????????? ?????????? ????????? ????????????? ???????????? ??? ?????????? ????????????? ????? ? ????????????? ???? ?? ?????? ?? ? ?? ????? ?????????? ??????? ?-13.
? ?? ?? ????? ???????????? ??? ????????? ????? ????????????? ?????????? ???????????? ? ????????? ??? ??? ?? ????????????? ????????? ?????????? ?? ?? ?????????? ???????. ? ???? ????? ?? ????????? ????? ????? ?????? ?? ???????????? ??????? ??????? ??? ?????????? ?? ? ?? ?? ????? ??????? ^{31}?.

?

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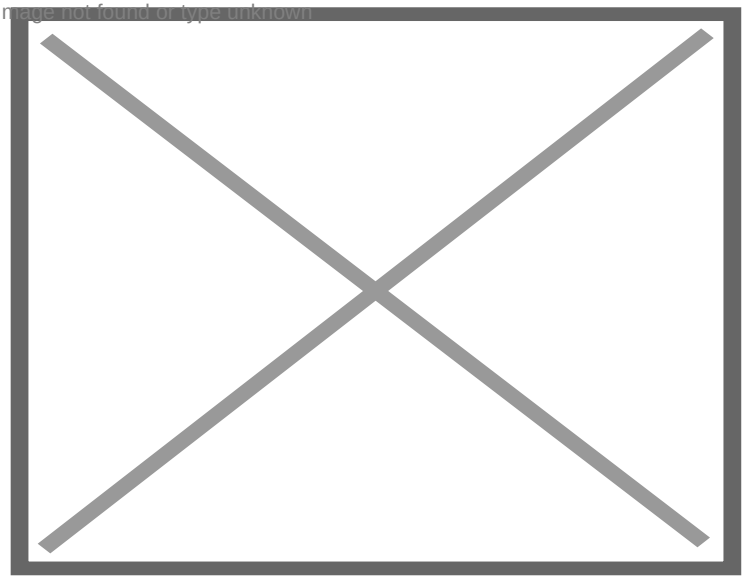

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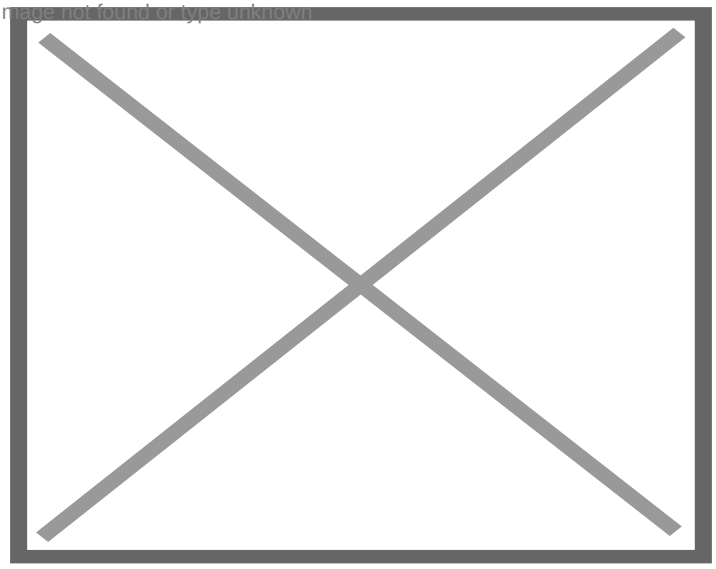

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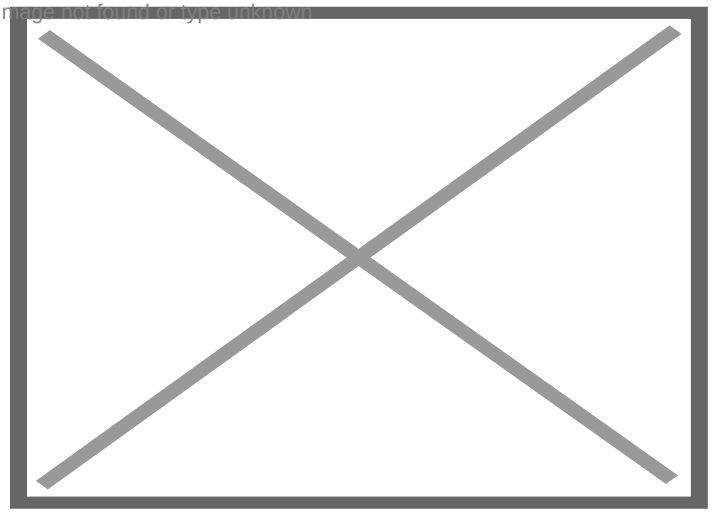
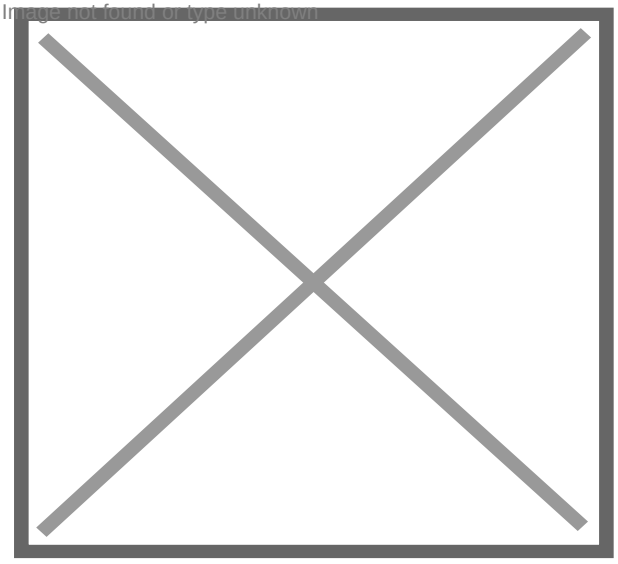
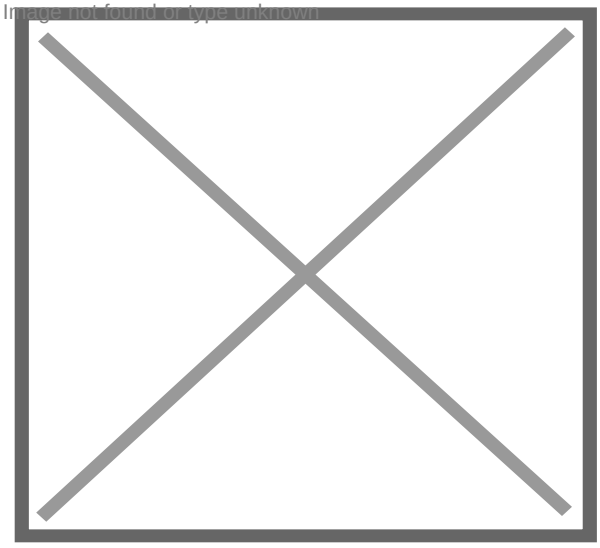
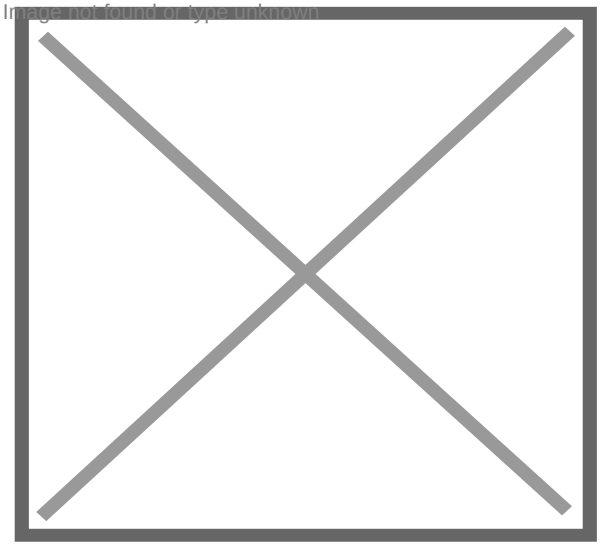


?







???. 5. ?????????? ??????? ??? ^{13}? ? ?????????????? ??????????? ???????? ?????????? ??: ? – ??????, ? – ?????-?????????. ????????? ?????????? I, II ? III ? ??????

Fig. 5. Stretched ^{13}? NMR spectra with broadband proton suppression of SC extracts: A – water,

B – hydroalcoholic. Assignment of ranges I, II and III in the text

??????????. ???????????????? ????????????, ??? ??????? ??? [13]? ?????-????????? ?????????? ??????????? ?????????? ? ????????? ??????????? ???????? ??????? ???????????????, ??? ????????? ???????????? ????? ?????????? ??????? ?-13 ??? ?????????? ????????????? ????? ? ????????????? ???? ?? ??? ??????.