Electronic Supplementary Material (ESI) for Green Chemistry.


**Supplementary information**

# Direct and one-pot conversion of polyguluronates and alginates into alkyl-L-guluronamide-based surfactant compositions

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**Fig.1** $^{1}H$ NMR spectrum ($CDCl_3$) of the mixture of lactone, furanose and pyranose guluronate monomers **1-3.** In Fig.1a, full spectrum; in Fig.1b, zoom of the anomeric $^{1}H$ area.

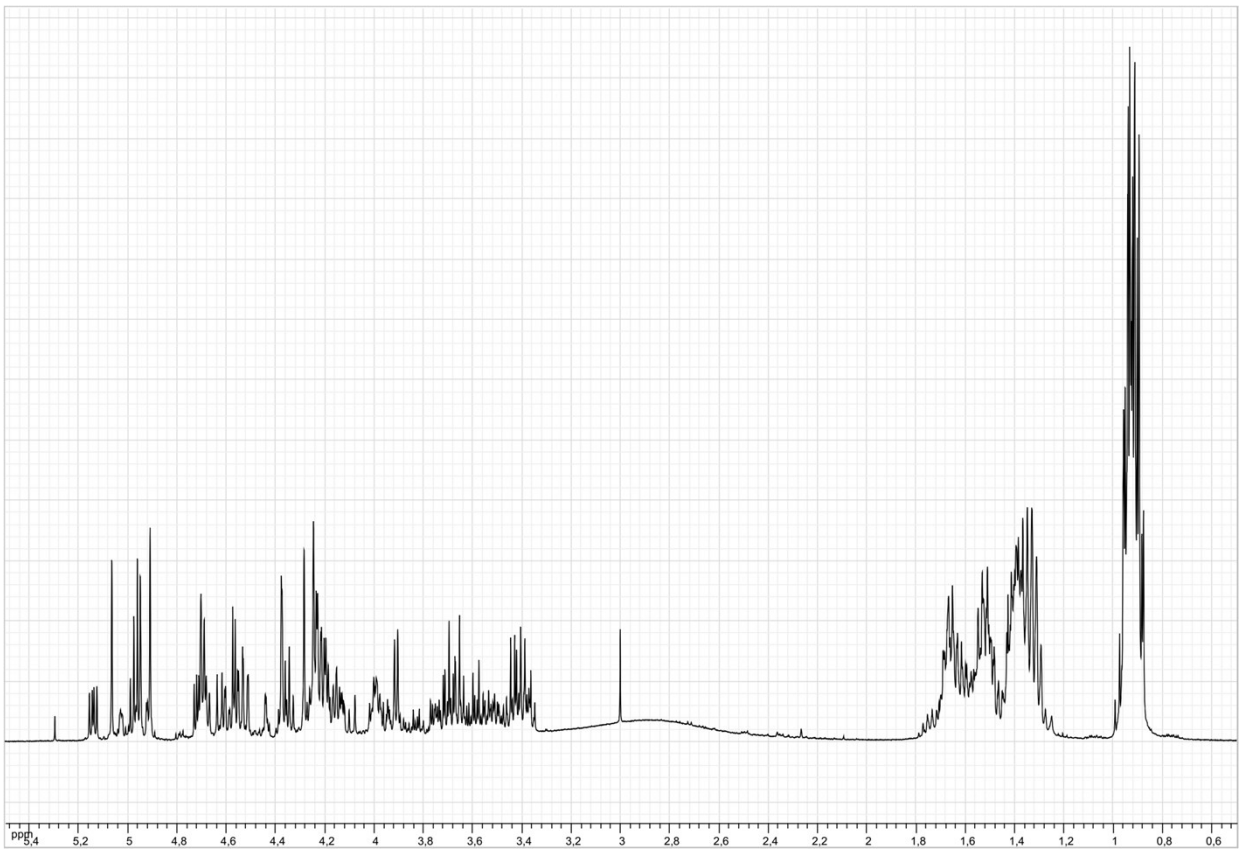


Fig.1a

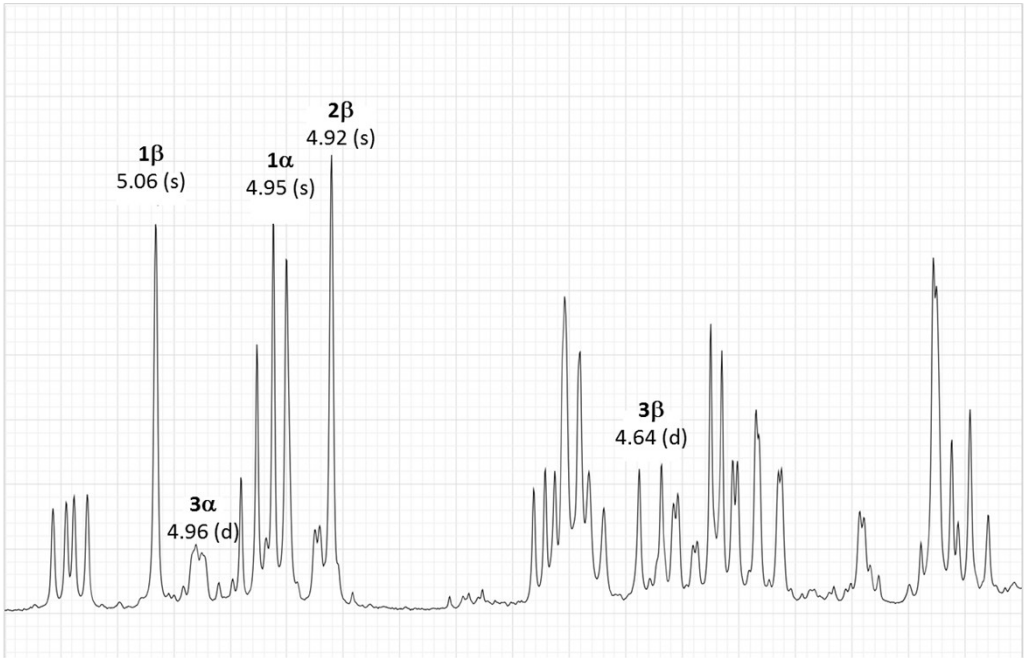


Fig.1b

**Fig.2** $^{1}$H NMR spectrum ($CDCl_3$) of a **Fraction I** enriched enriched in isomer **4α**, α-L-Gul*f* (major product) and isomer **4β**, β-L-Gul*f* (minor product), isolated after silica gel column chromatography of the **$GulC_4N_{12}$** composition. In Fig.2a, full spectrum; in Fig.2b, zoom of the anomeric $^{1}$H area.

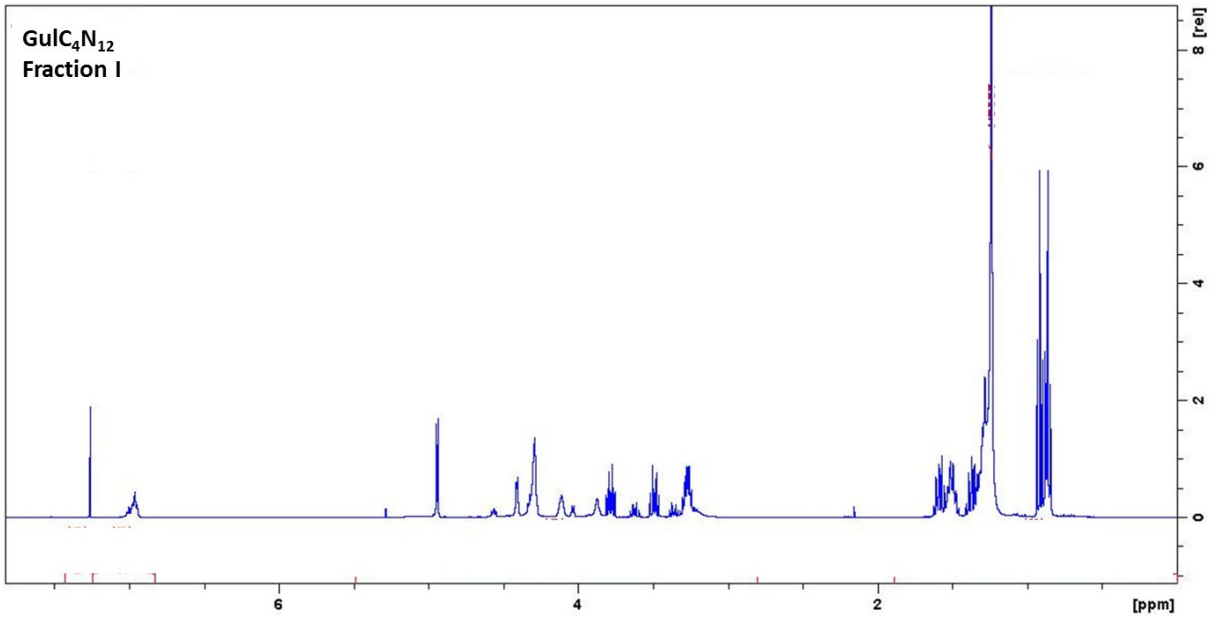


Fig.2a

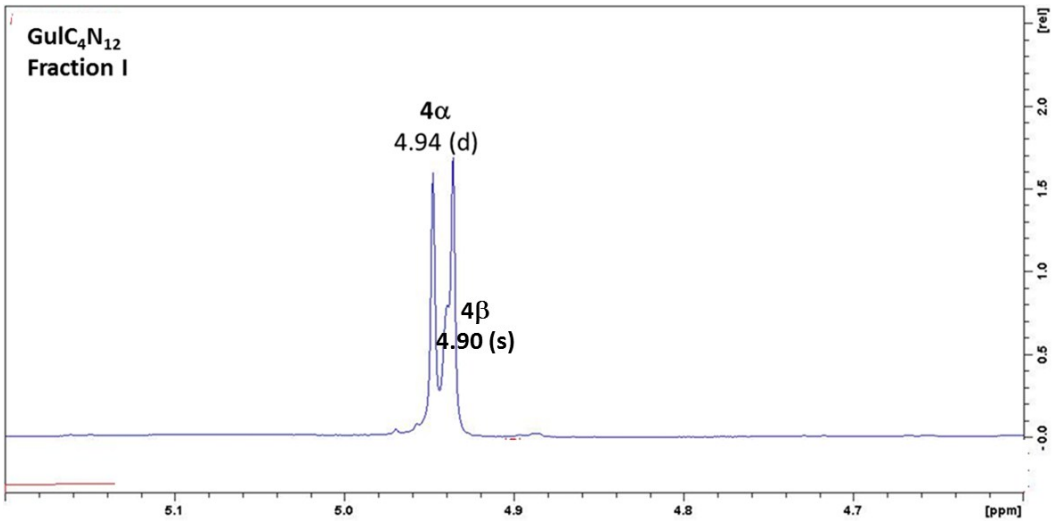


Fig.2b

**Fig.3** $^{13}C$ (JMod) NMR spectrum ($CDCl_3$) of a **Fraction I** enriched in isomer **4α**, α-L-Gul*f* (major product) and isomer **4β**, β-L-Gul*f* (minor product), isolated after silica gel column chromatography of the **$GulC_4N_{12}$** composition. In Fig.3a, full spectrum; in Fig.3b, zoom of the anomeric $^{13}C$ area.

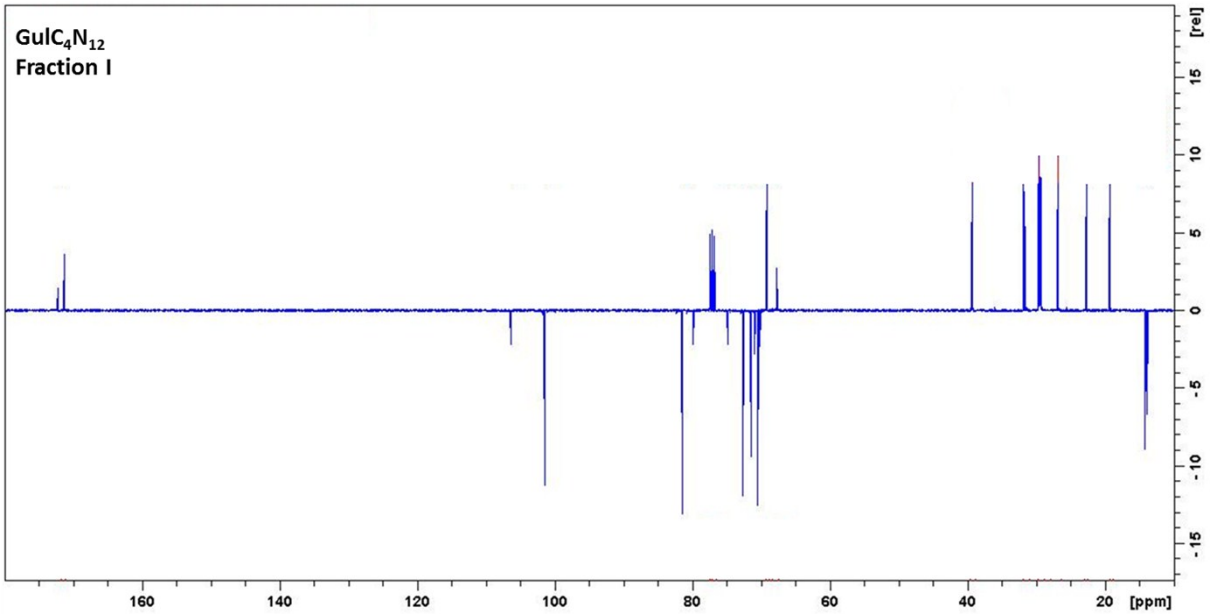


Fig.3a

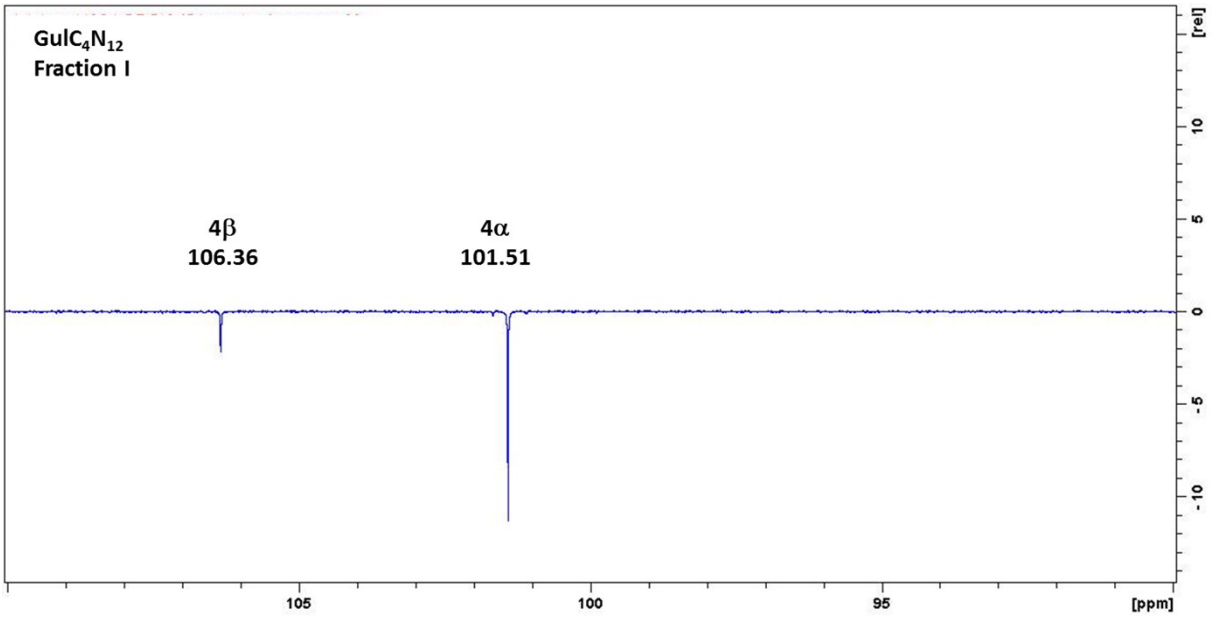


Fig.3b

**Fig.4** $^{1}$H NMR spectrum ($CDCl_3$) of a **Fraction II** enriched in isomer **6α**, α-L-Gul*p,* (major product) and isomer **4β**, β-L-Gul*f* (minor product), isolated after silica gel column chromatography of the **$GulC_4N_{12}$** composition. In Fig.4a, full spectrum; in Fig.4b, zoom of the anomeric $^{1}$H area.

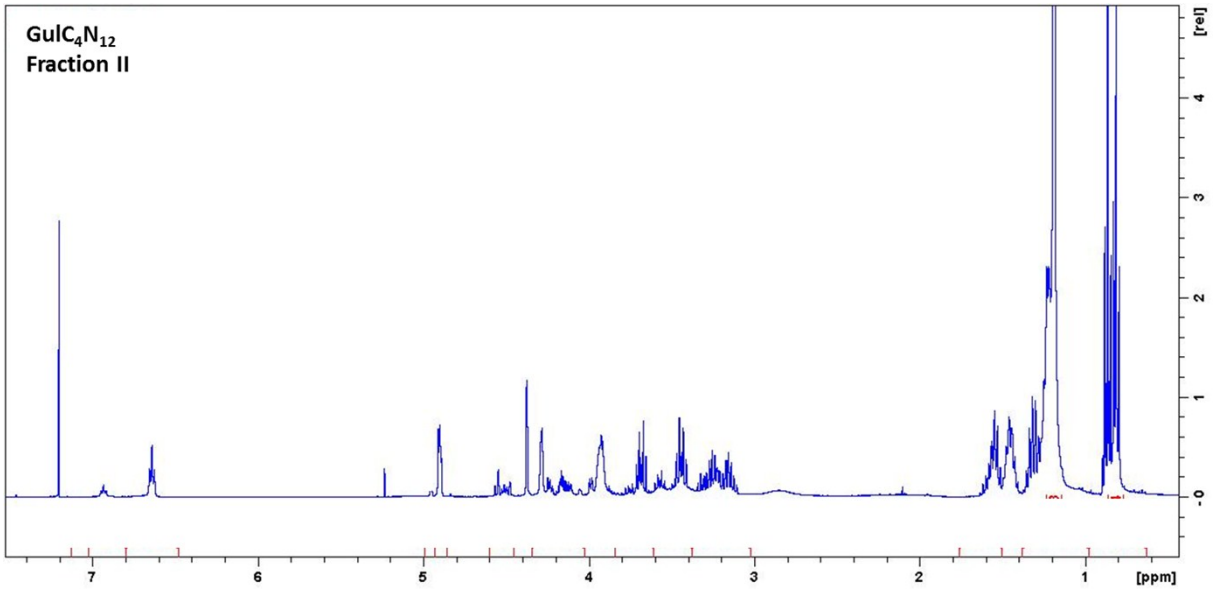


Fig.4a

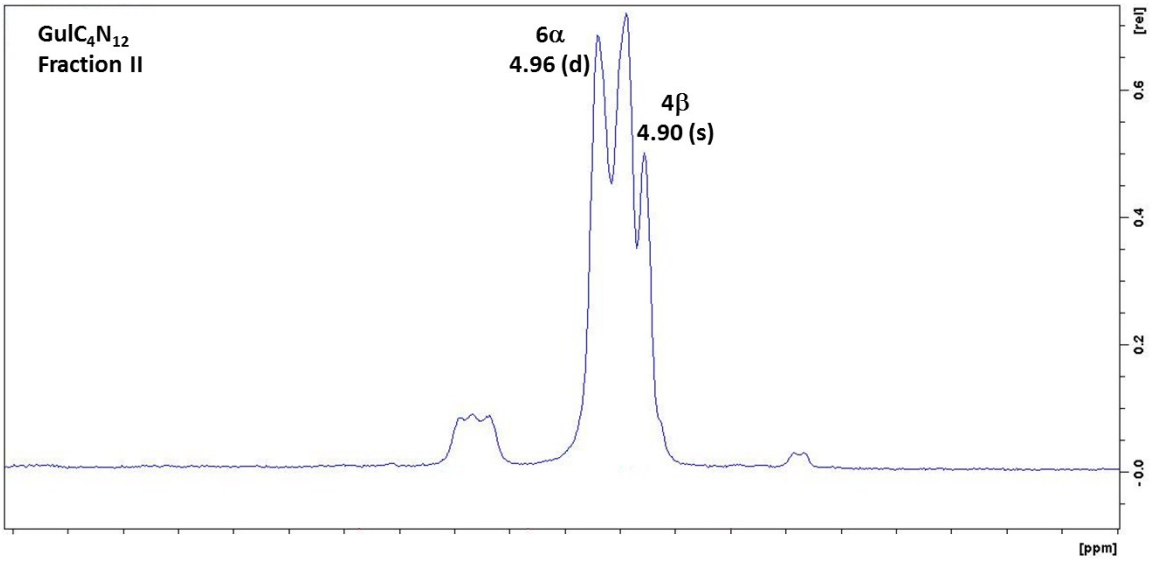


Fig.4b

**Fig.5** $^{13}C$ (JMod) NMR spectrum ($CDCl_3$) of a **Fraction II** enriched in isomer **6α**, α-L-Gul*p,* (major product) and isomer **4β**, β-L-Gul*f* (minor product), isolated after silica gel column chromatography of the **$GulC_4N_{12}$** composition. In Fig.5a, full spectrum; in Fig.5b, zoom of the anomeric $^{13}C$ area.

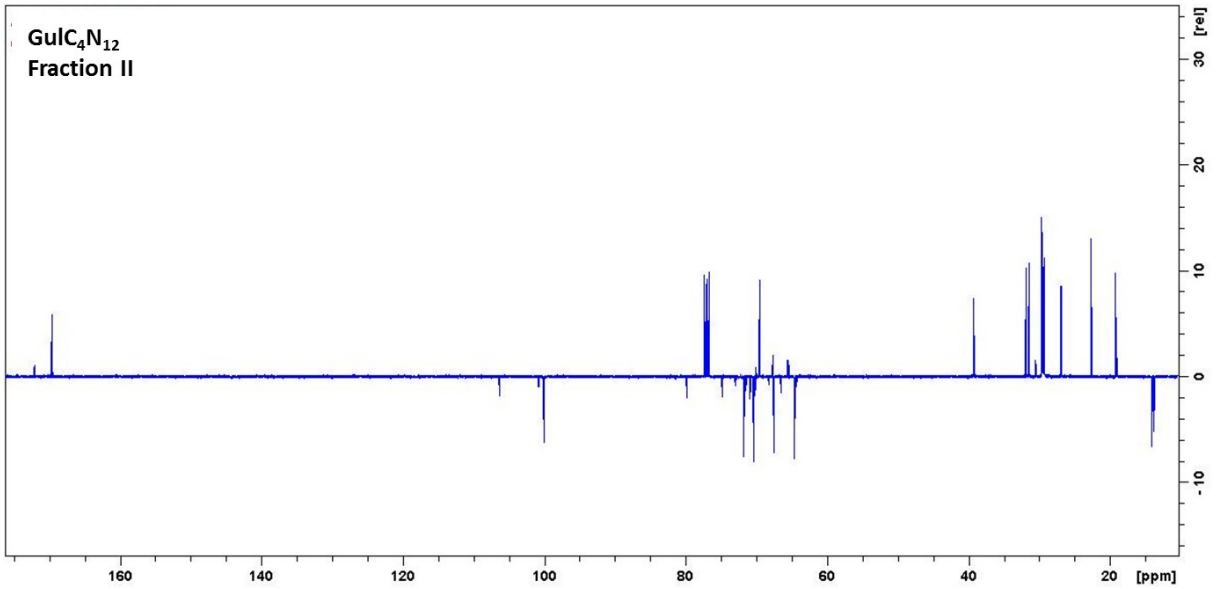


Fig.5a

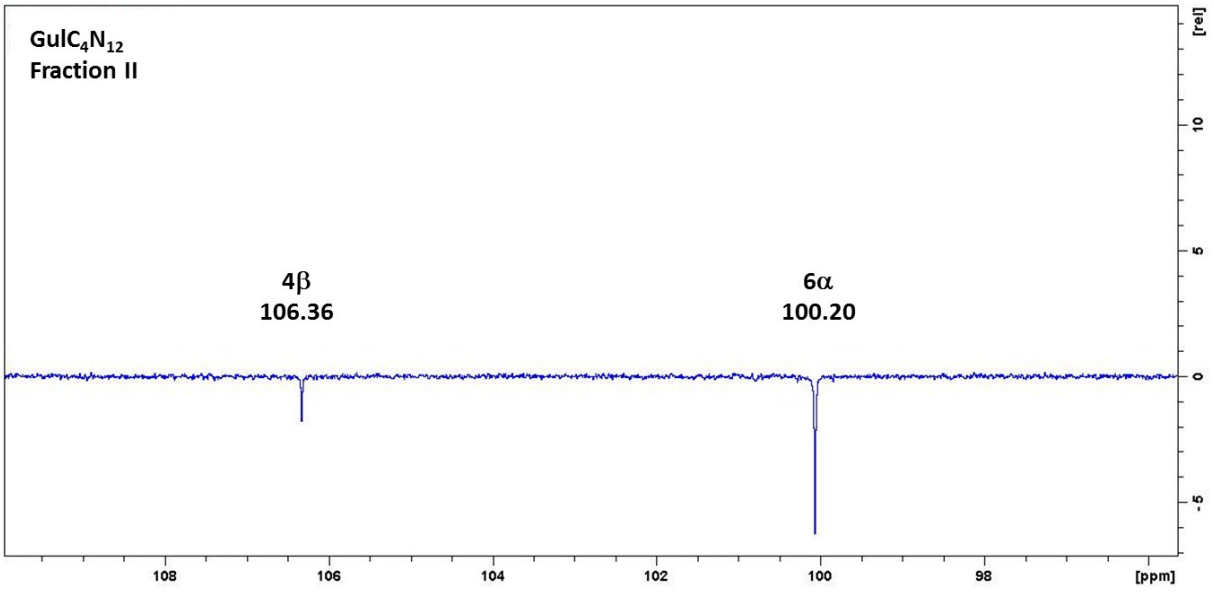


Fig.5b

**Fig.6** $^{1}$H NMR spectrum ($CDCl_3$) of a **Fraction III** enriched in isomer **6β**, β-L-Gul*p*, isolated after silica gel column chromatography of the **$GulC_4N_{12}$** composition. In Fig.6a, full spectrum; in Fig.6b, zoom of the anomeric $^{1}$H area.

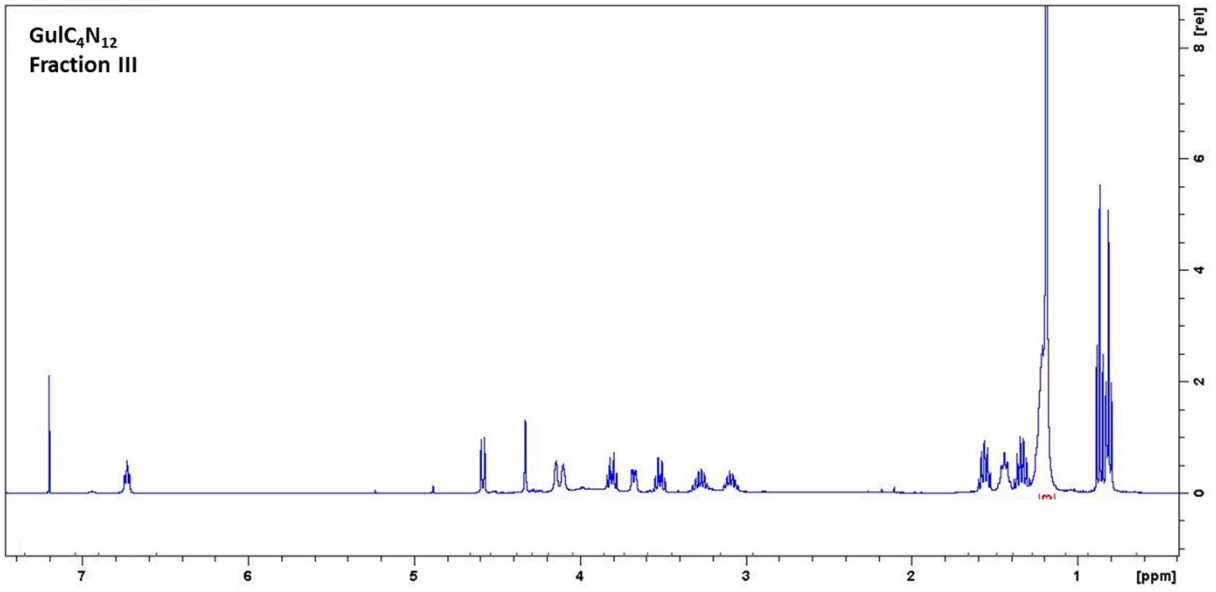


Fig.6a

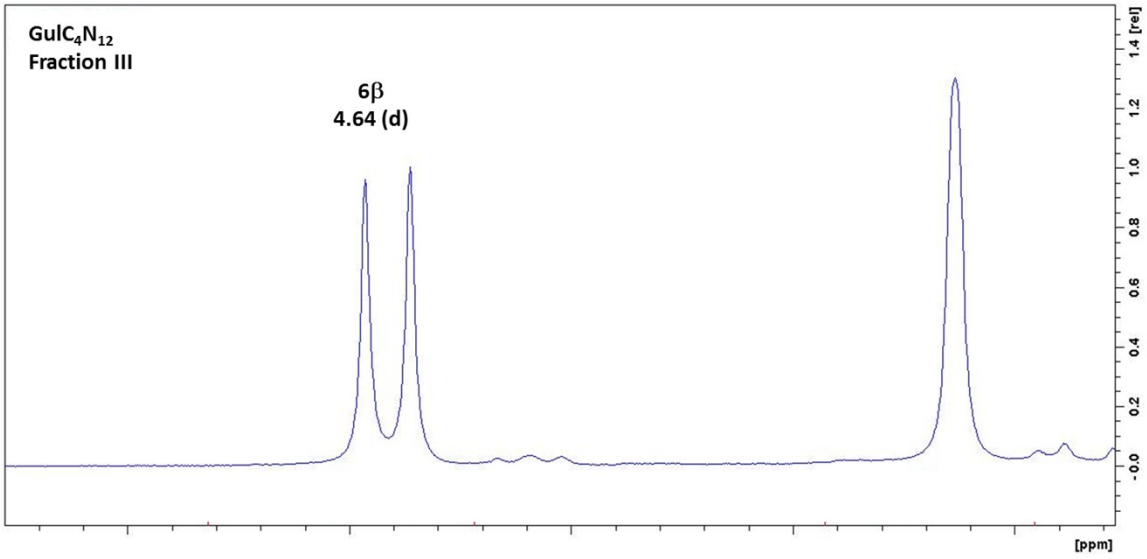


Fig.6b

**Fig.7** $^{13}C$ (JMod) NMR spectrum ($CDCl_3$)) of a **Fraction III** enriched in isomer **6β**, β-L-Gul*p*, isolated after silica gel column chromatography of the **$GulC_4N_{12}$** composition. In Fig.7a, full spectrum; in Fig.7b, zoom of the anomeric $^{13}C$ area.

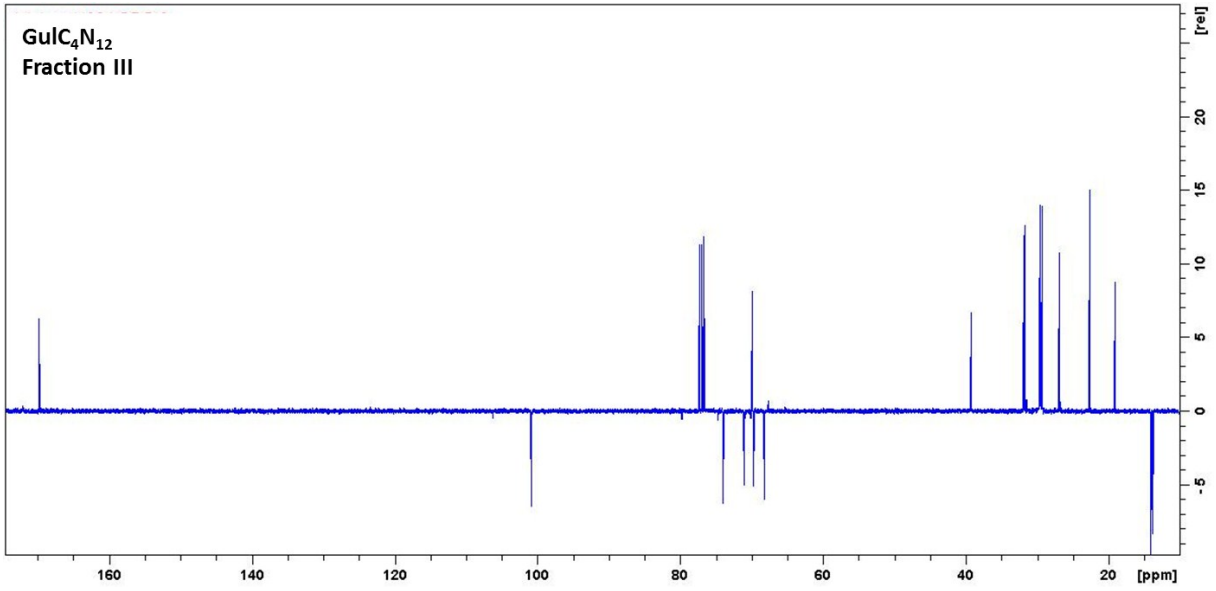


Fig.7a

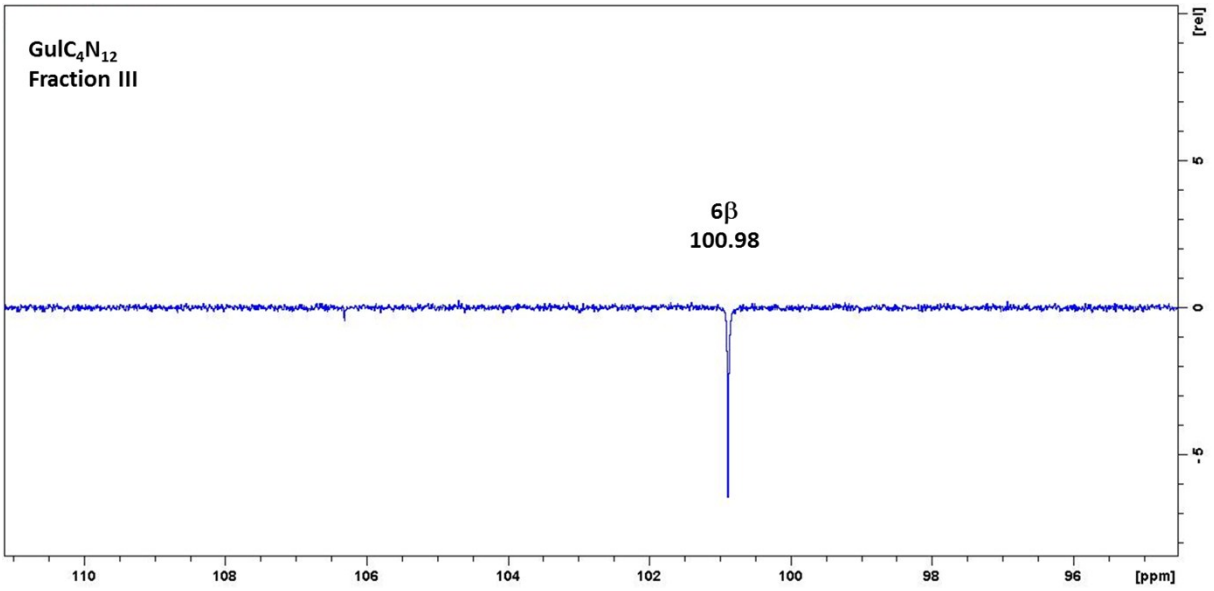


Fig.7b

**Fig.8** $^{1}$H NMR spectrum ($CDCl_3$) of a **Fraction I** enriched enriched in isomer **5α**, α-L-Gul*f* (major product) and isomer **5β**, β-L-Gul*f* (minor product), isolated after silica gel column chromatography of the **$GulC_4N_{18}$** composition. In Fig.8a, full spectrum; in Fig.8b, zoom of the anomeric $^{1}$H area.

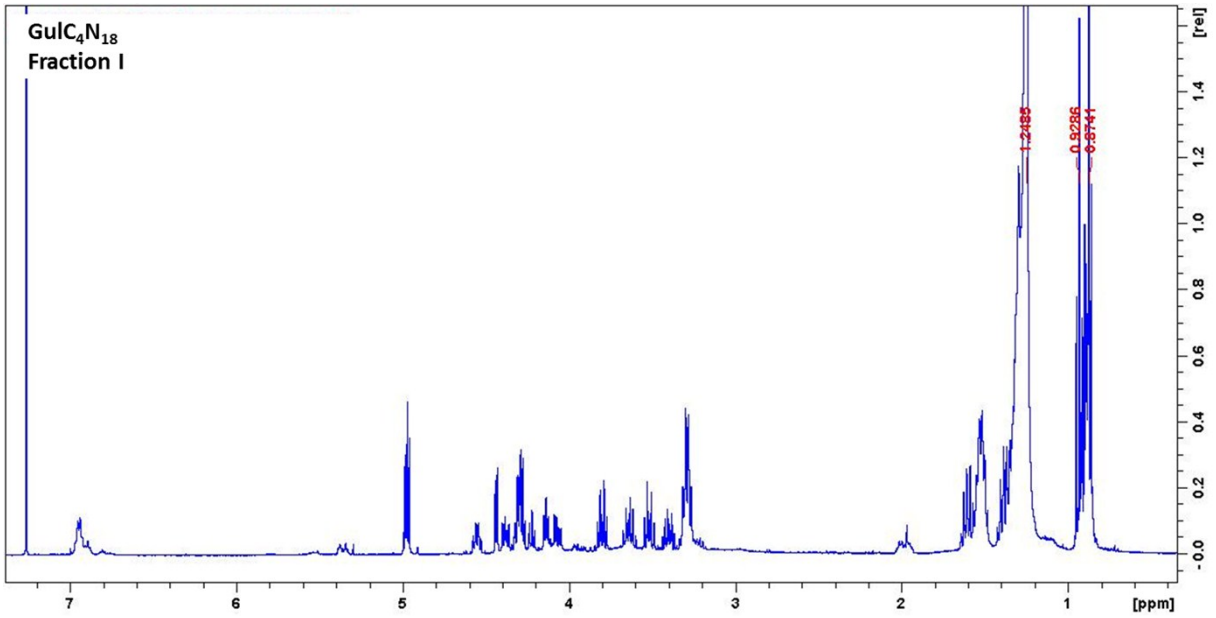


Fig.8a

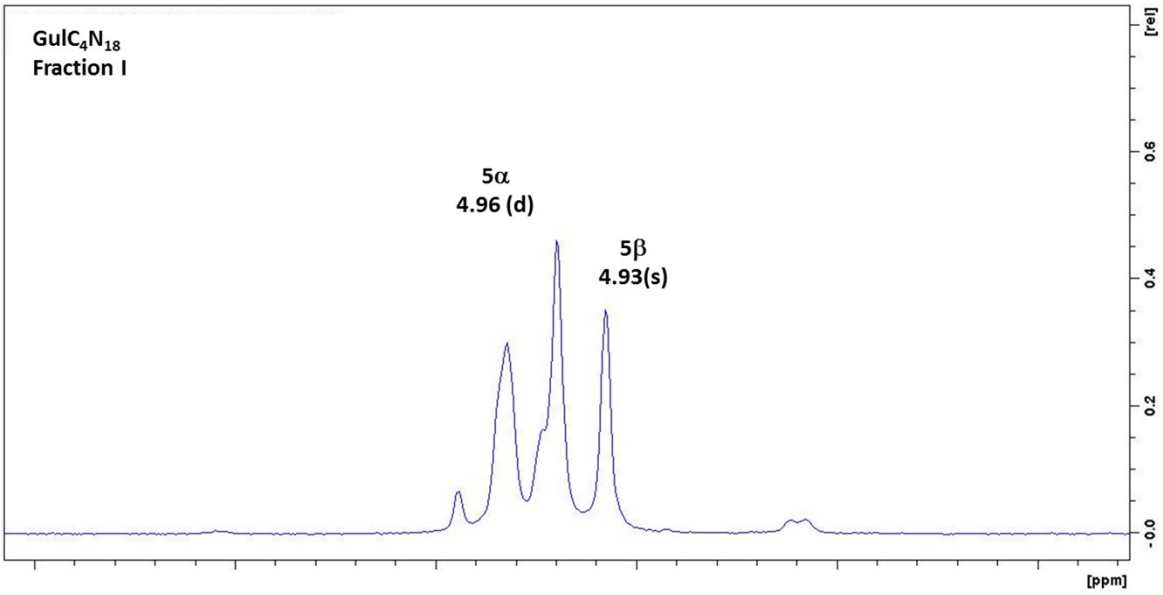


Fig.8b

**Fig.9** $^{13}C$ (JMod) NMR spectrum ($CDCl_3$) of a **Fraction I** enriched in isomer **5α**, α-L-Gul*f* (major product) and isomer **5β**, β-L-Gul*f* (minor product), isolated after silica gel column chromatography of the **$GulC_4N_{18}$** composition. In Fig.9a, full spectrum; in Fig.9b, zoom of the anomeric $^{13}C$ area.

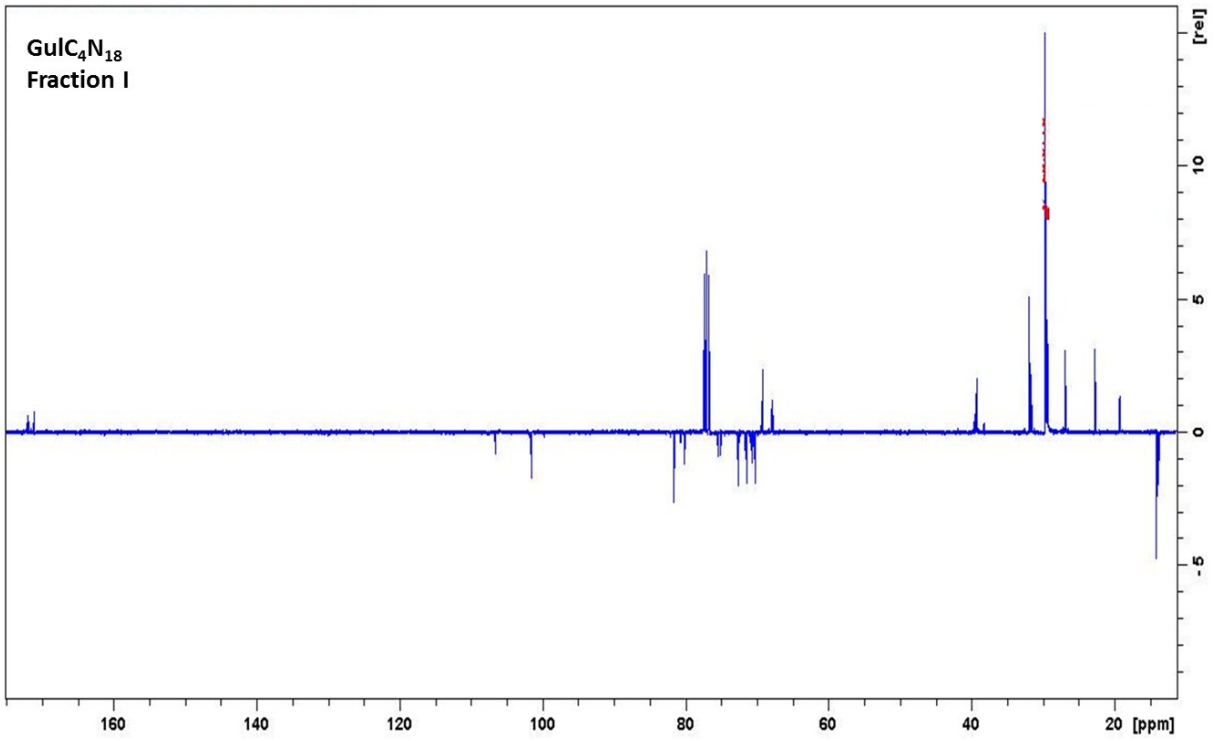


Fig.9a

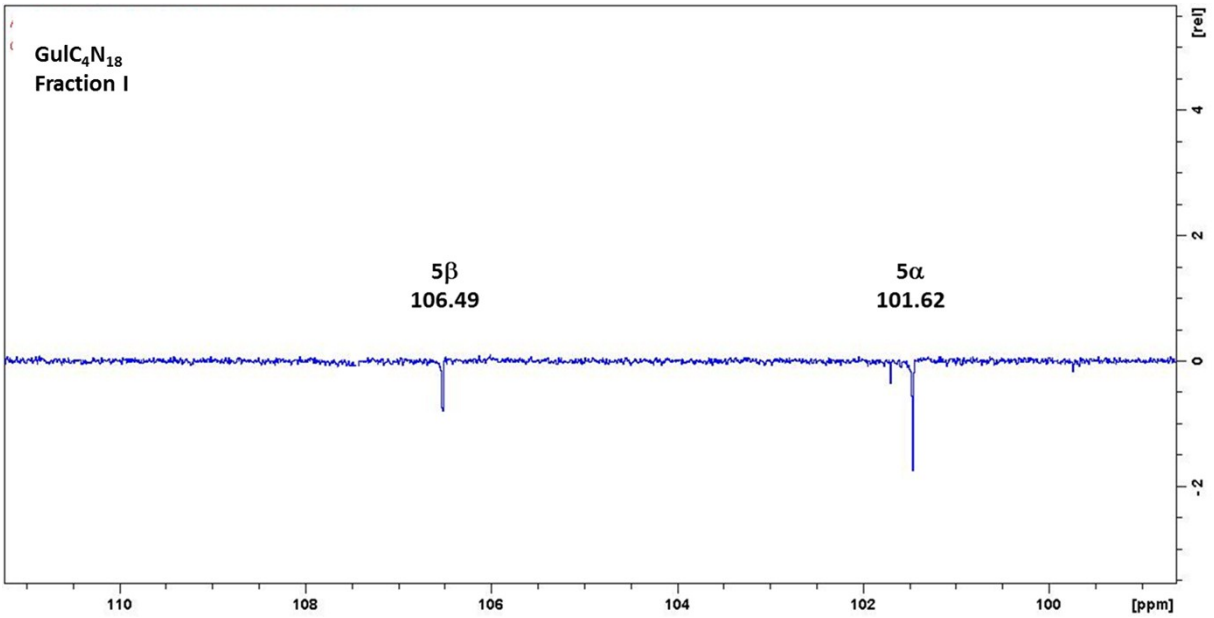


Fig.9b

**Fig.10** $^{1}$H NMR spectrum ($CDCl_3$) of a **Fraction II** enriched in isomer **7α**, α-L-Gul*p,* (major product) and isomers **5β**, β-L-Gul*f* and **7β**, β-L-Gul*p* (minor products), isolated after silica gel column chromatography of the **$GulC_4N_{18}$** composition. In Fig.10a, full spectrum; in Fig.10b, zoom of the anomeric $^{1}$H area.

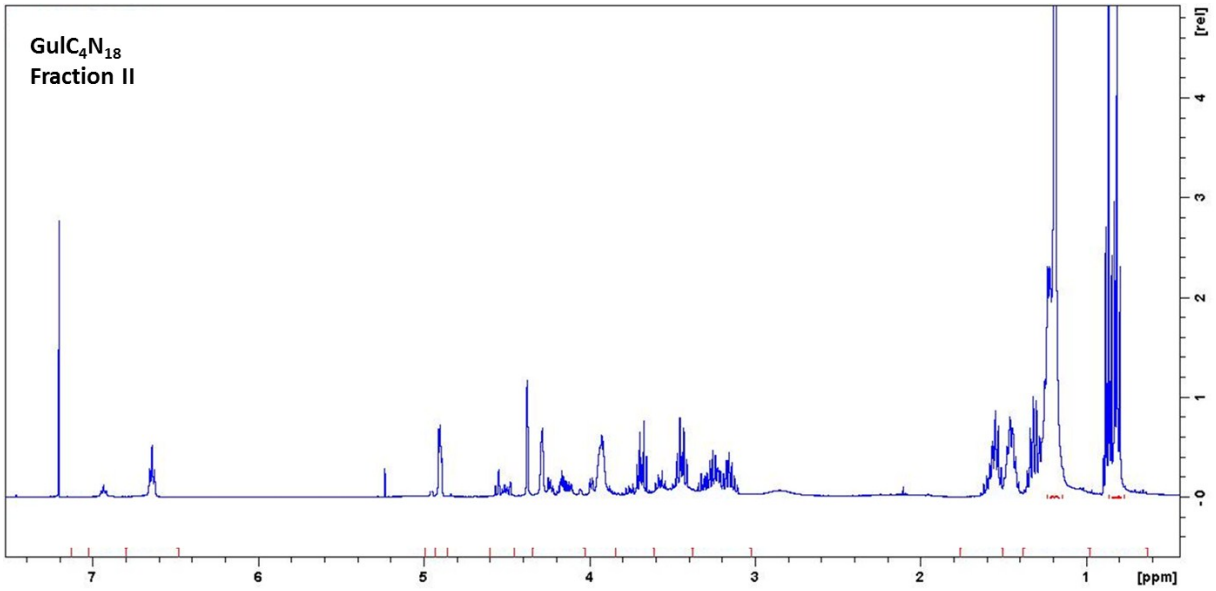


Fig.10a

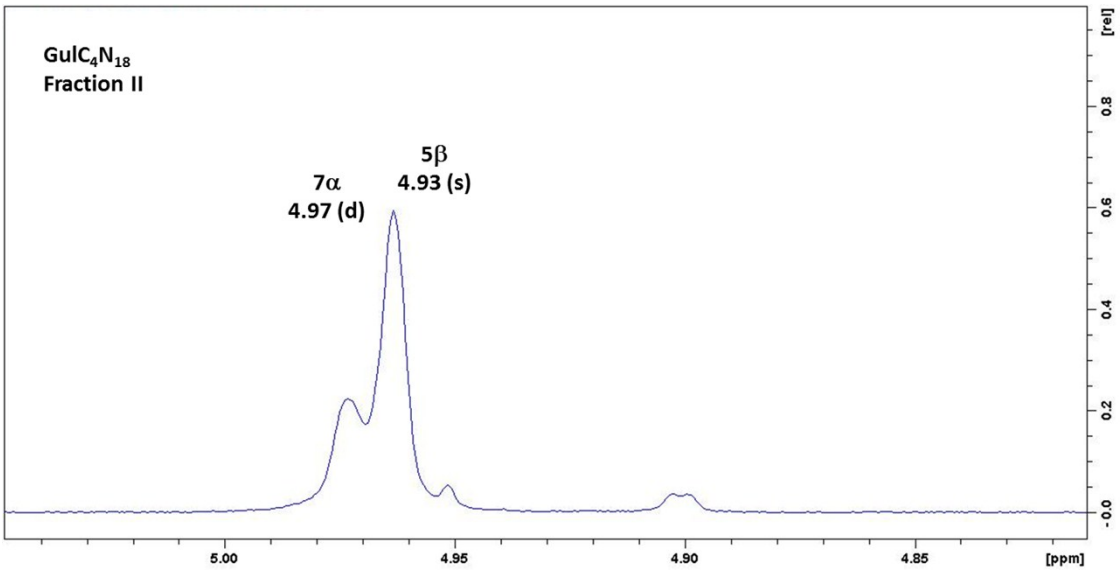


Fig.10b

**Fig.11** $^{13}C$ (JMod) NMR spectrum ($CDCl_3$) of a **Fraction II** enriched in isomer **7α**, α-L-Gul*p,* (major product) and isomers **5β**, β-L-Gul*f* and **7β**, β-L-Gul*p* (minor products), isolated after silica gel column chromatography of the **$GulC_4N_{18}$** composition. In Fig.11a, full spectrum; in Fig.11b, zoom of the anomeric $^{13}C$ area.

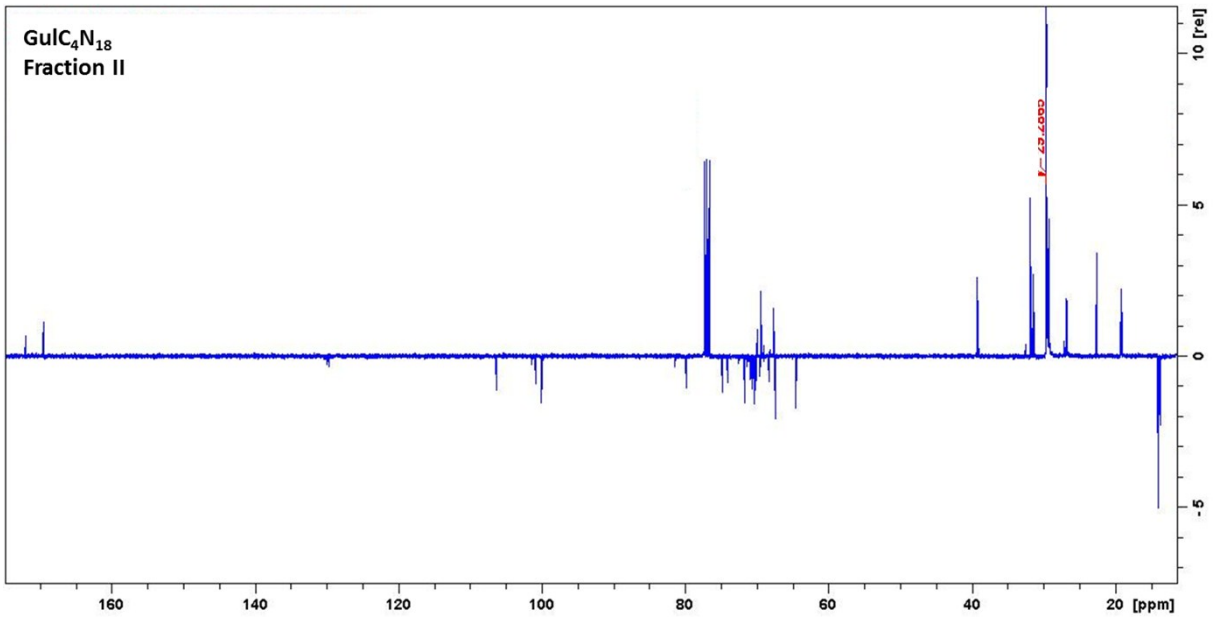


Fig.11a

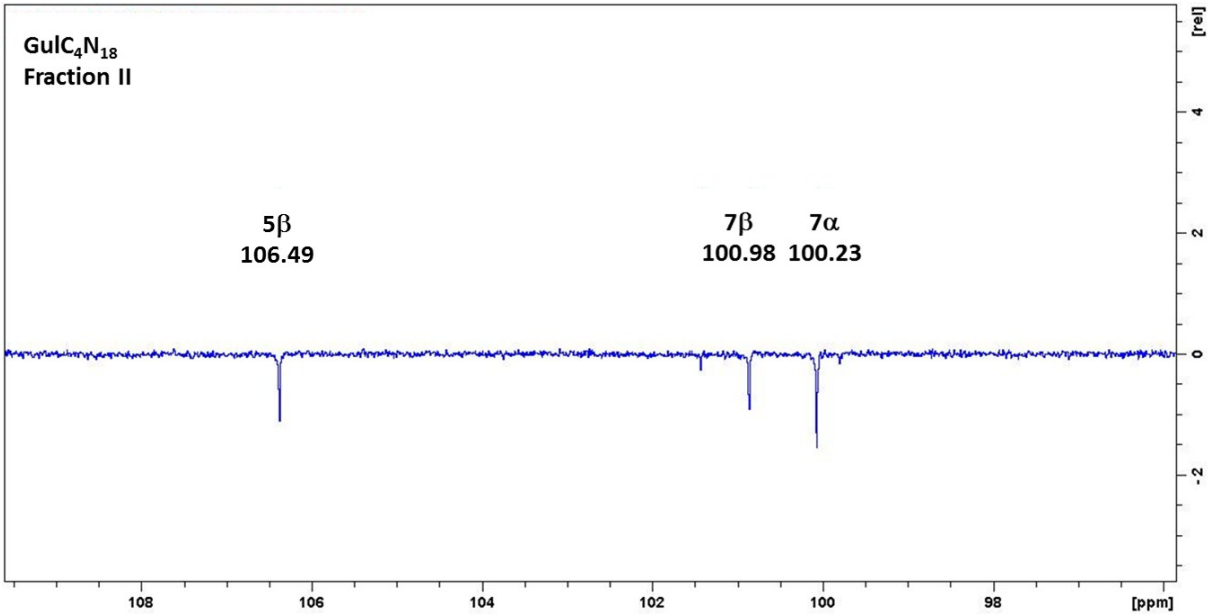


Fig.11b

**Fig.12** $^{1}$H NMR spectrum ($CDCl_3$) of a **Fraction III** enriched in isomer **7β**, β-L-Gul*p*, isolated after silica gel column chromatography of the **$GulC_4N_{18}$** composition. In Fig.12a, full spectrum; in Fig.12b, zoom of the anomeric $^{1}$H area.

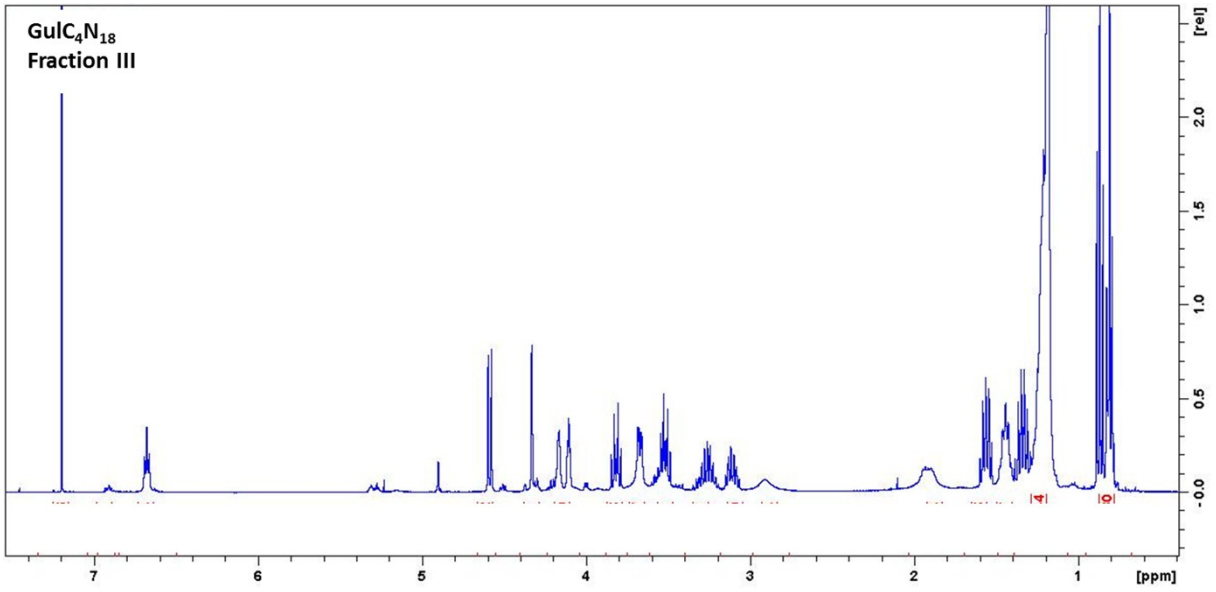


Fig.12a

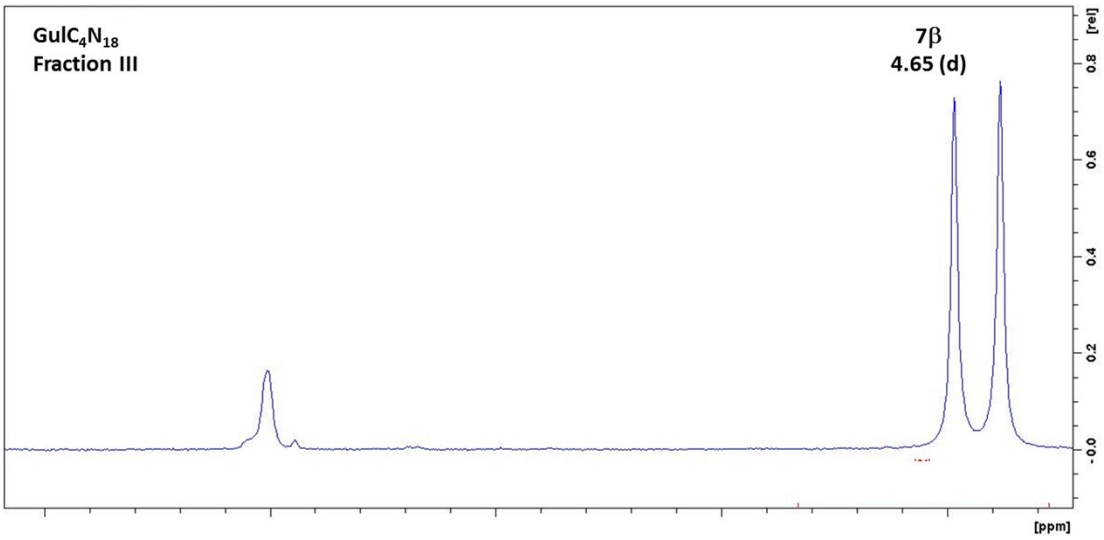


Fig.12b

**Fig.13** $^{13}C$ (JMod) NMR spectrum ($CDCl_3$) of a **Fraction III** enriched in isomer **7β**, β-L-Gul*p*, isolated after silica gel column chromatography of the **$GulC_4N_{18}$** composition. In Fig.13a, full spectrum; in Fig.13b, zoom of the anomeric $^{13}C$ area.

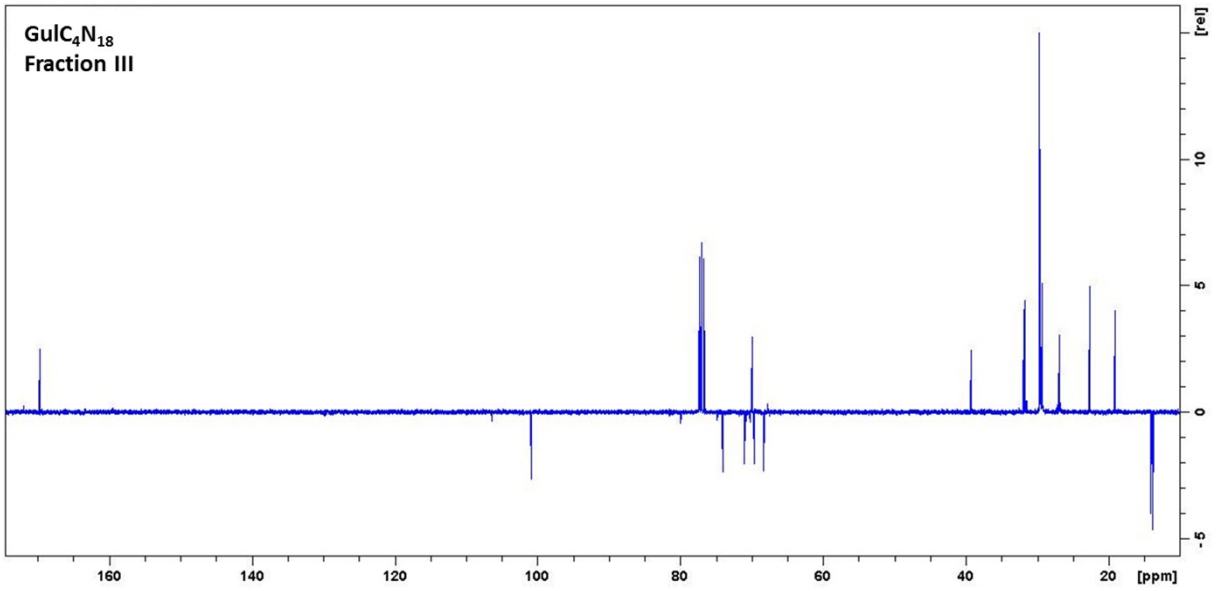


Fig.13a

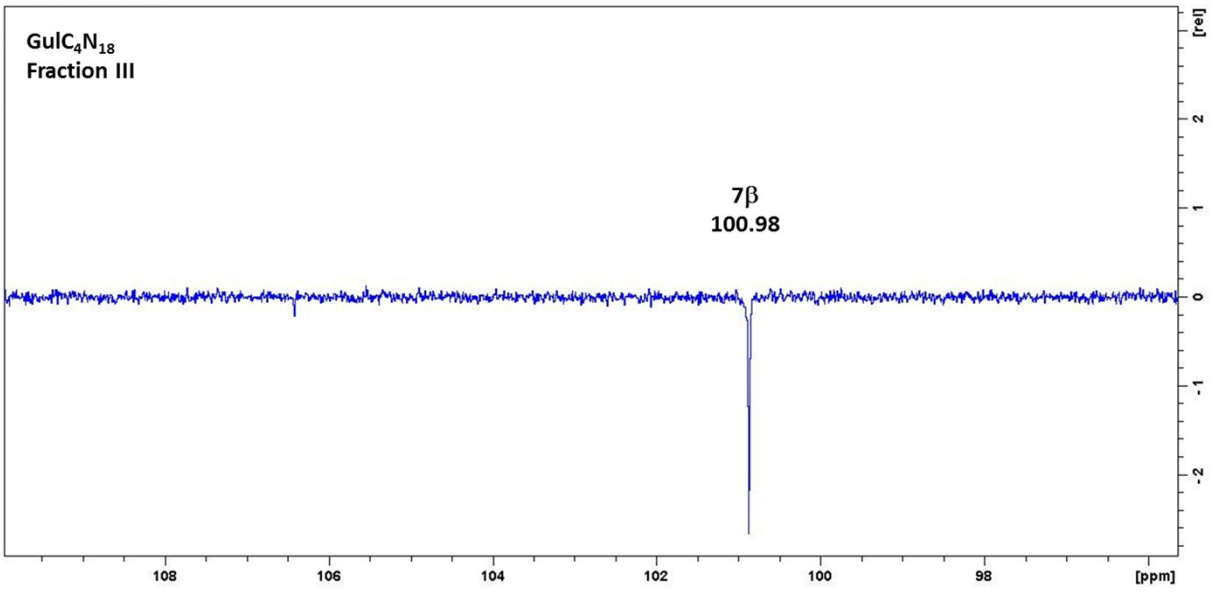


Fig.13b

**Fig.14** $^{1}$H NMR spectrum ($CDCl_3$) of a **Fraction I** enriched in isomer **8α**, α-D-Man*f* (major product) and isomer **4α**, α-L-Gul*f* (minor product), isolated after silica gel column chromatography of the **$AlgC_4N_{12}$** composition. In Fig.14a, full spectrum; in Fig.14b, zoom of the anomeric $^{1}$H area.

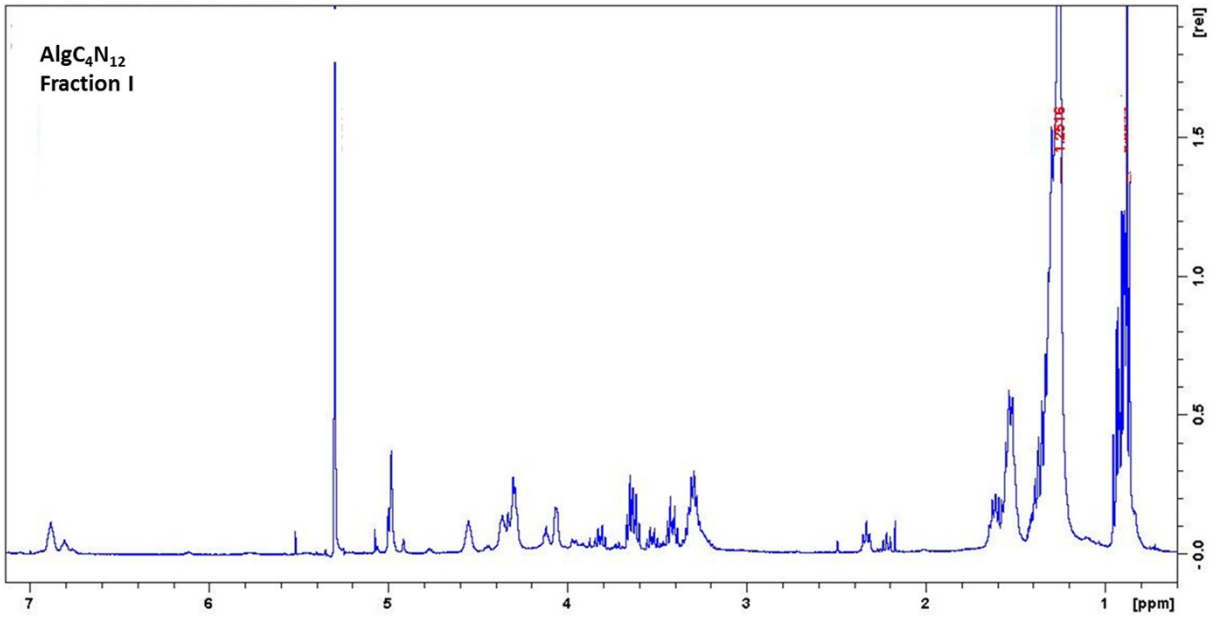


Fig.14a

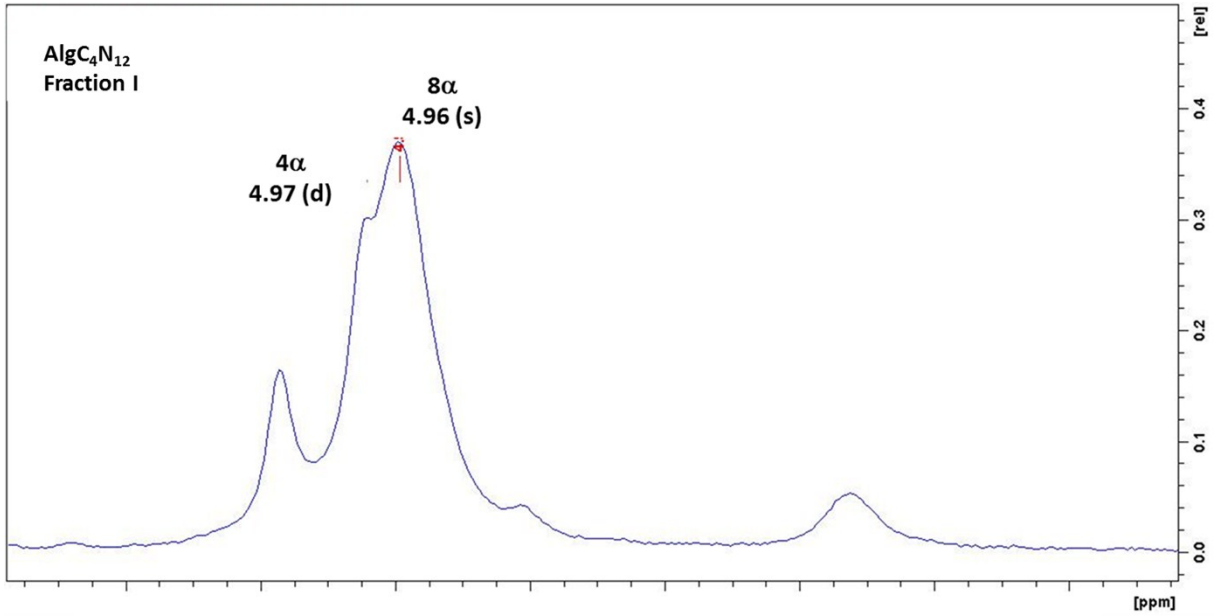


Fig.14b

**Fig.15** $^{13}C$ (JMod) NMR spectrum ($CDCl_3$) of a **Fraction I** enriched in isomer **8α**, α-D-Man*f* (major product) and isomer **4α**, α-L-Gul*f* (minor product), isolated after silica gel column chromatography of the **$AlgC_4N_{12}$** composition. In Fig.15a, full spectrum; in Fig.15b, zoom of the anomeric $^{13}C$ area.

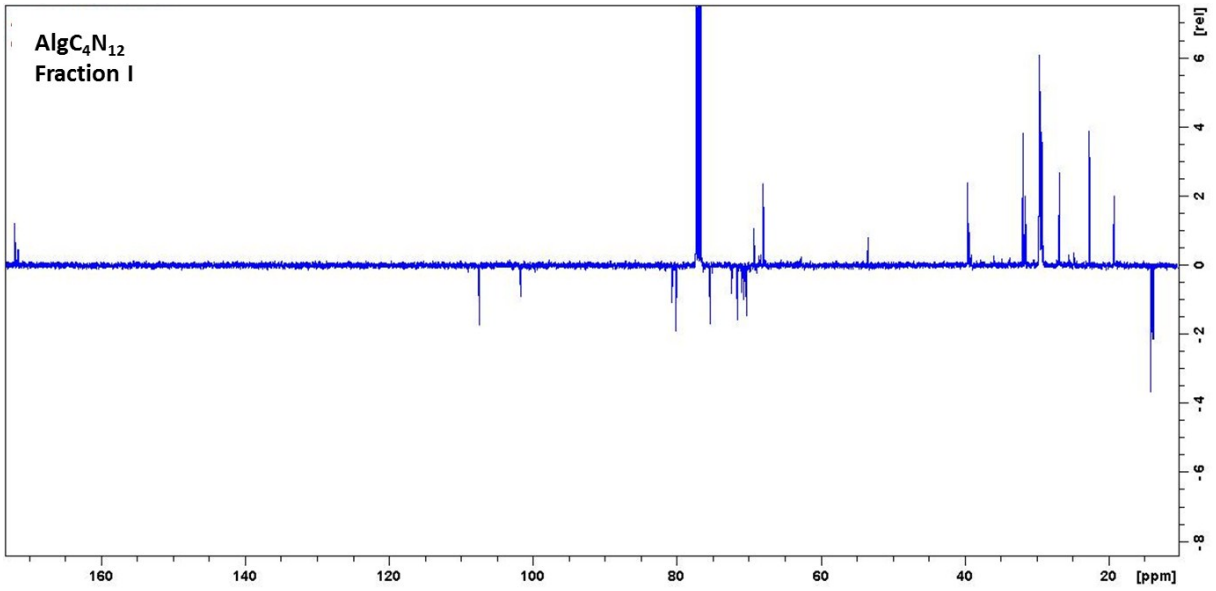


Fig.15a

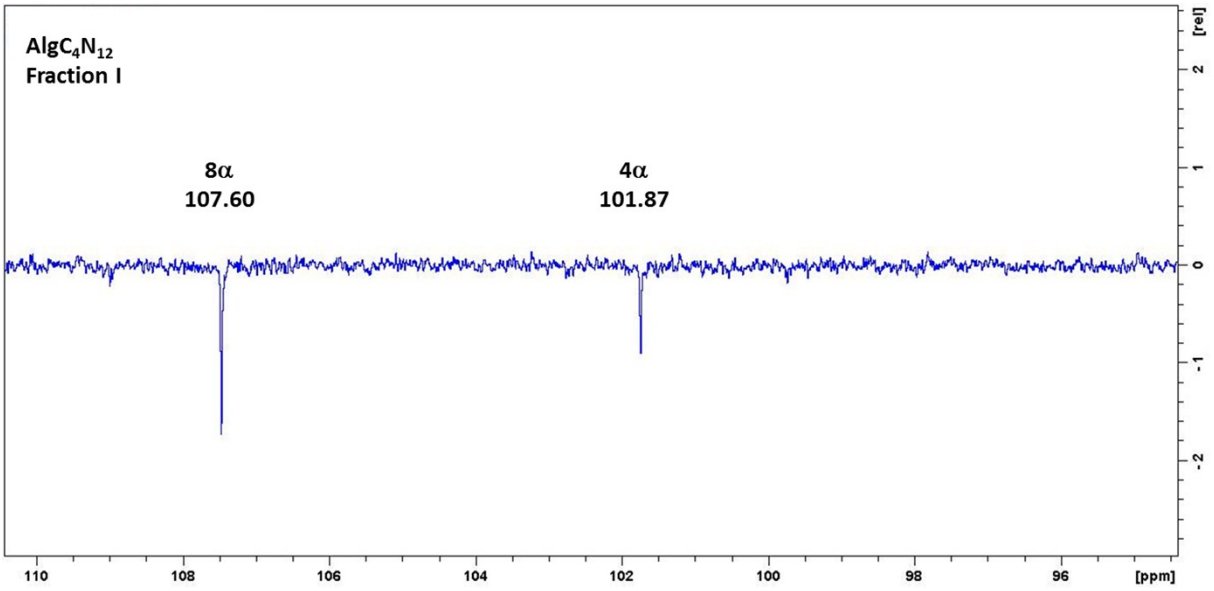


Fig.15b

**Fig.16** $^{1}$H NMR spectrum ($CDCl_3$) of a **Fraction II** enriched in isomer **4β**, β-L-Gul*f* (major product) and isomers **4α**, α-L-Gul*f* and **10α**, α-D-Man*p* (minor products), isolated after silica gel column chromatography of the **$AlgC_4N_{12}$** composition. In Fig.16a, full spectrum; in Fig.16b, zoom of the anomeric $^{1}$H area.

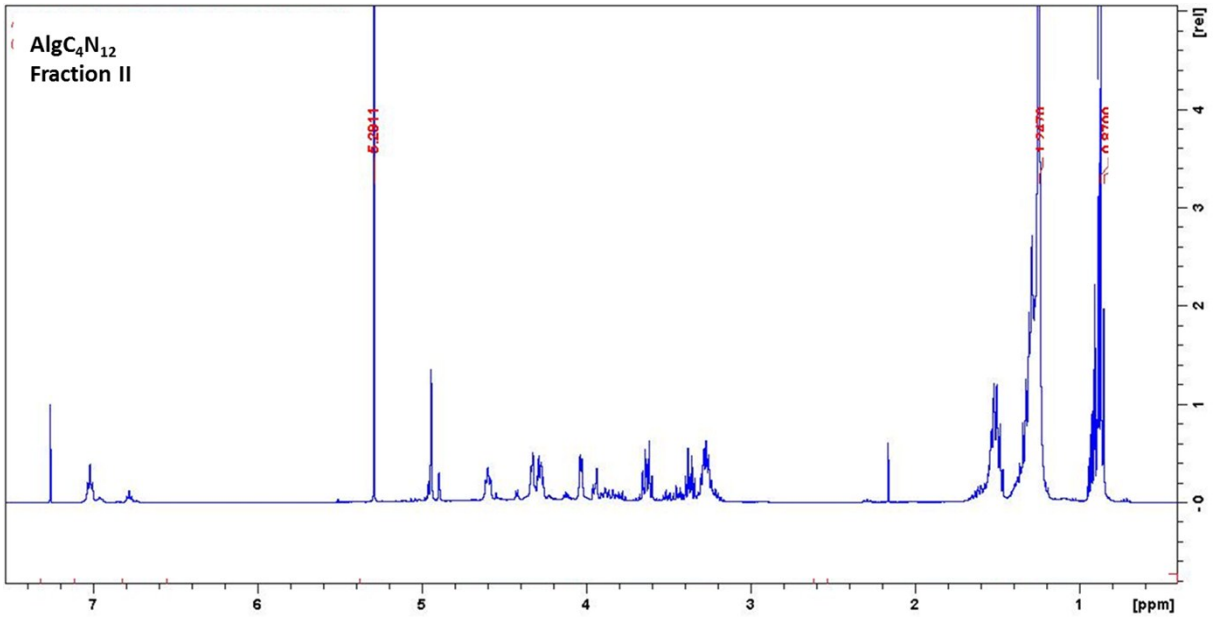


Fig.16a

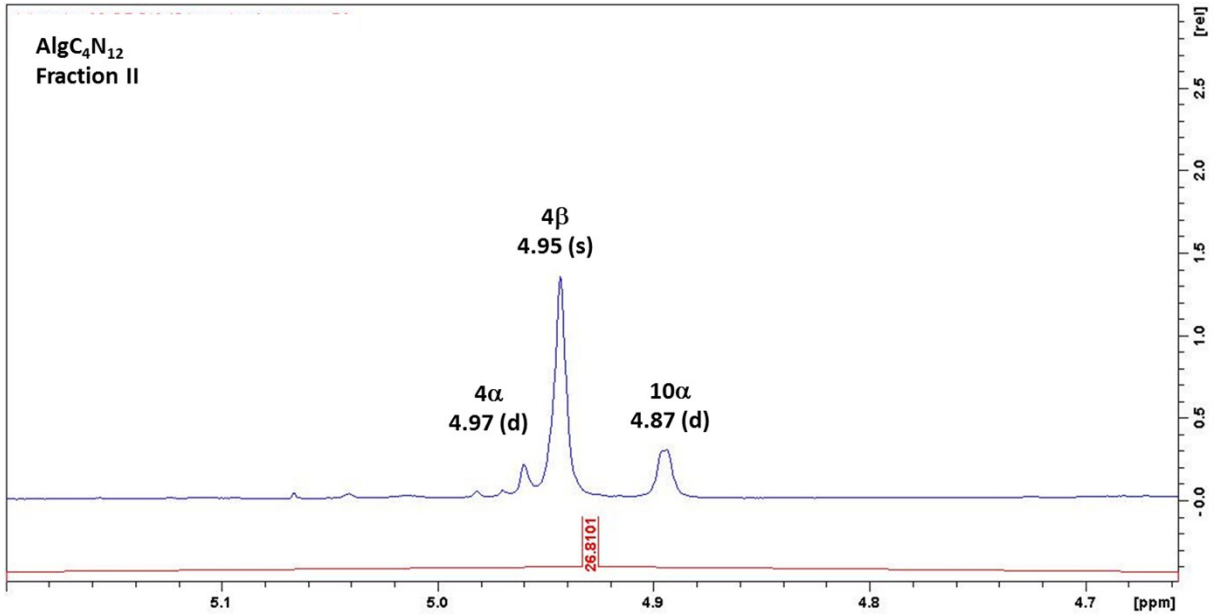


Fig.16b

**Fig.17** $^{13}C$ (JMod) NMR spectrum ($CDCl_3$) of a **Fraction II** enriched in isomer **4β**, β-L-Gul*f* (major product) and isomers **4α**, α-L-Gul*f* and **10α**, α-D-Man*p* (minor products), isolated after silica gel column chromatography of the **$AlgC_4N_{12}$** composition. In Fig.17a, full spectrum; in Fig.17b, zoom of the anomeric $^{13}C$ area.

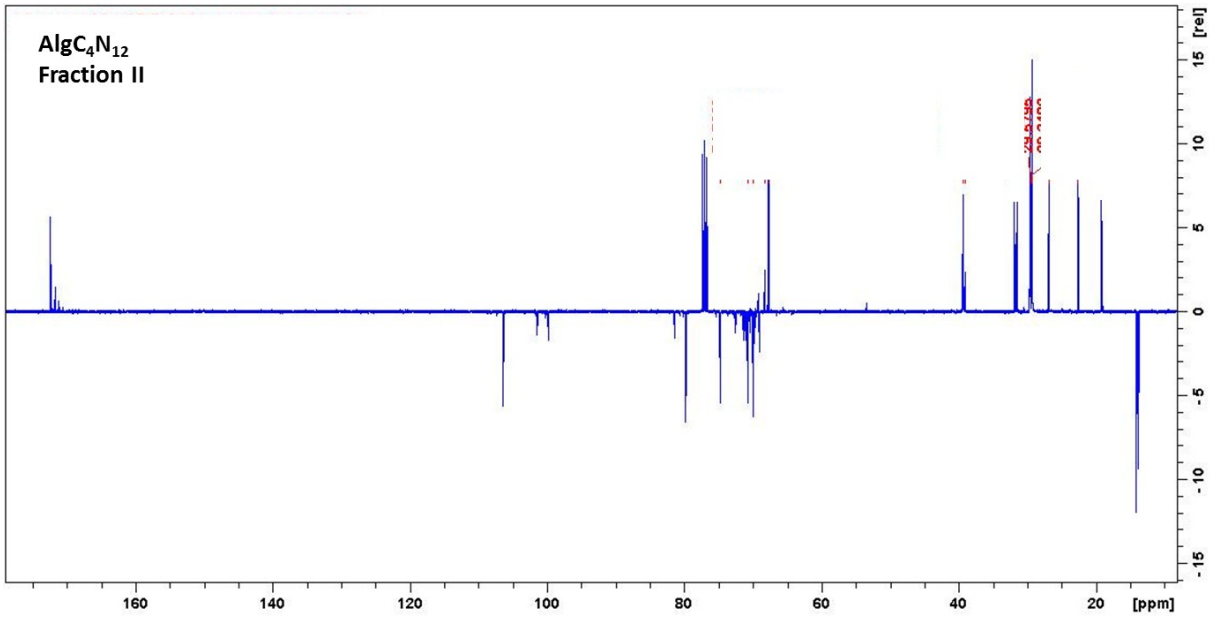


Fig.17a

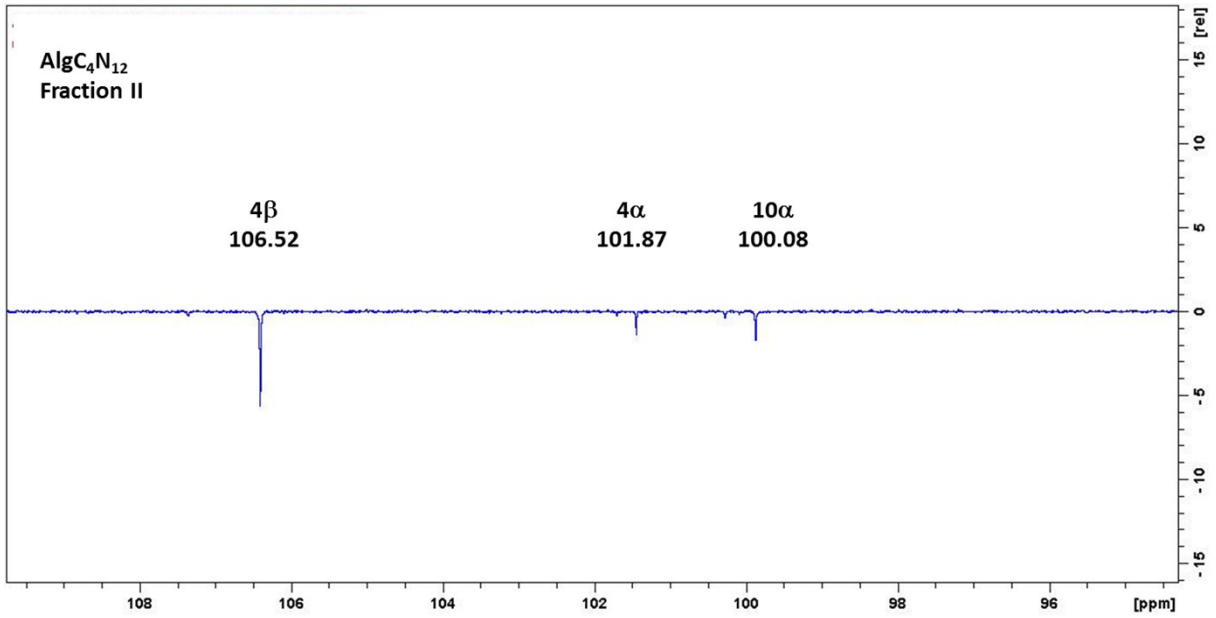


Fig.17b

**Fig.18** $^{1}$H NMR spectrum ($CDCl_3$) of a **Fraction III** enriched in isomer **6α**, α-L-Gul*p* isolated after silica gel column chromatography of the **$AlgC_4N_{12}$** composition. In Fig.18a, full spectrum; in Fig.18b, zoom of the anomeric $^{1}$H area.

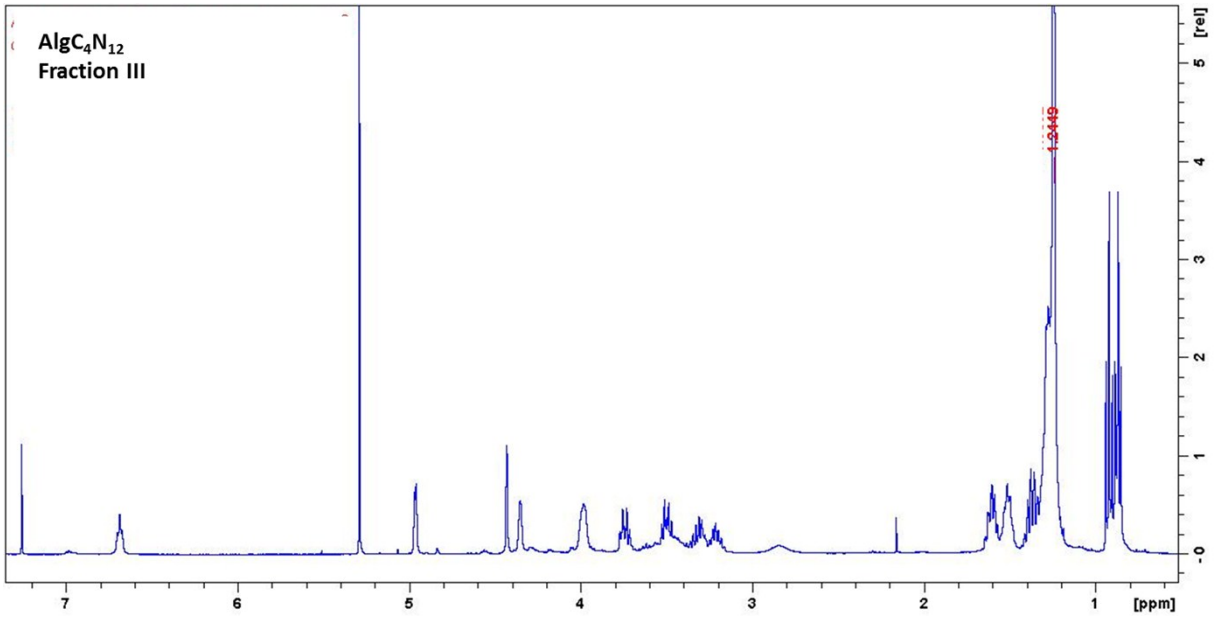


Fig.18a

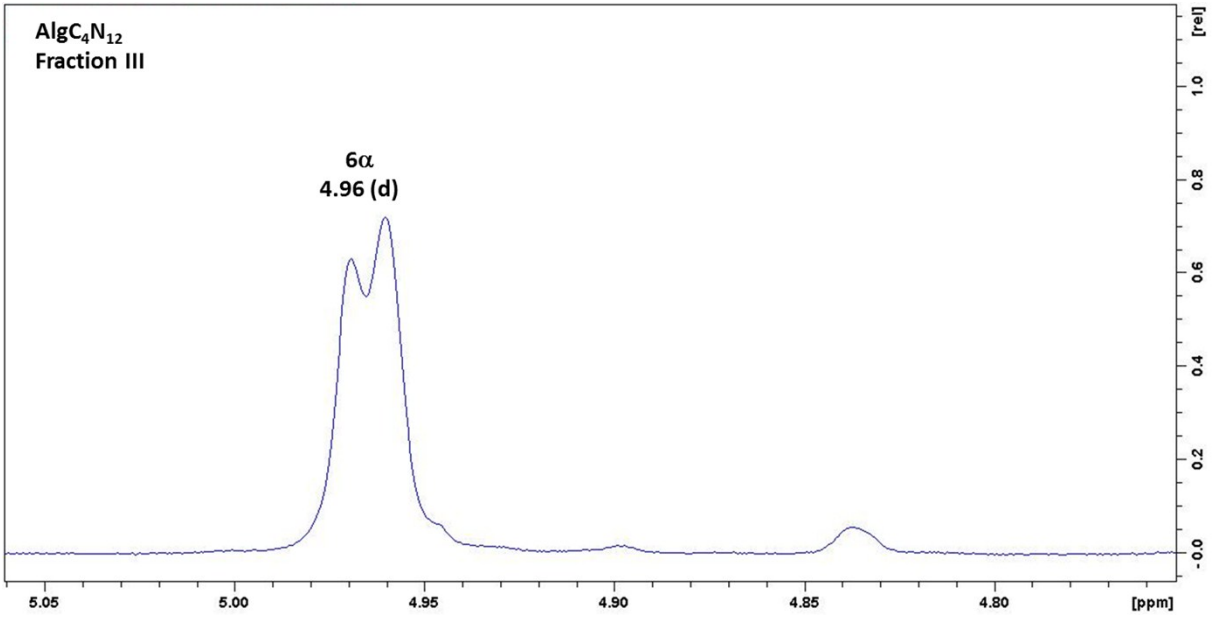


Fig.18b

**Fig.19** $^{13}C$ (JMod) NMR spectrum ($CDCl_3$) of a **Fraction III** enriched in isomer **6α**, α-L-Gul*p* isolated after silica gel column chromatography of the **$AlgC_4N_{12}$** composition. In Fig.19a, full spectrum; in Fig.19b, zoom of the anomeric $^{13}C$ area.

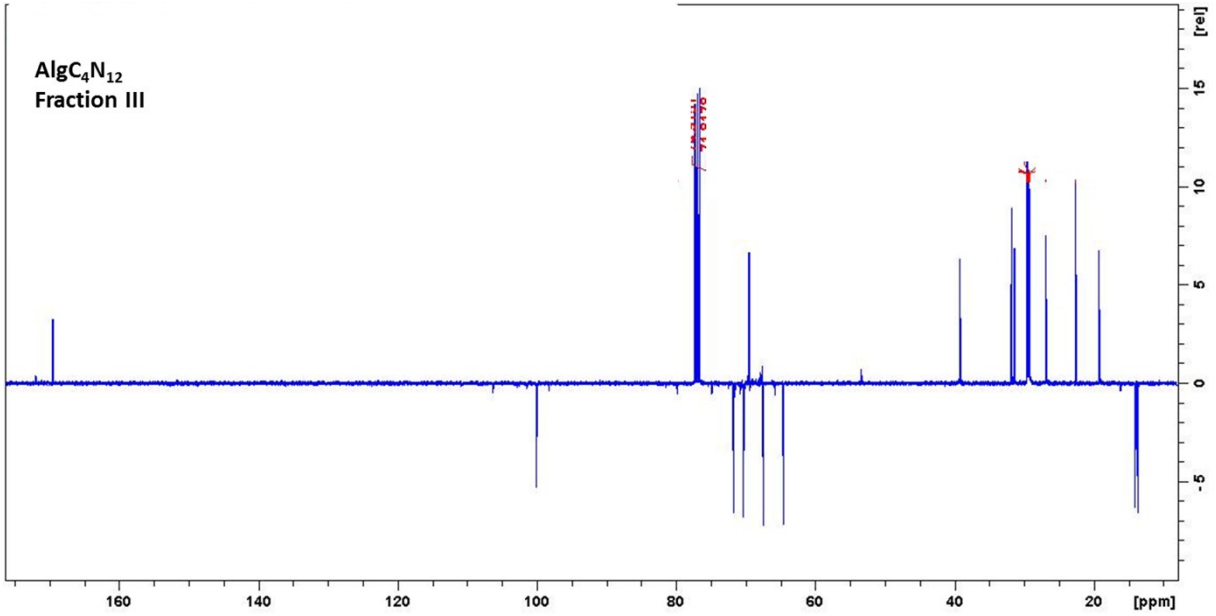


Fig.19a

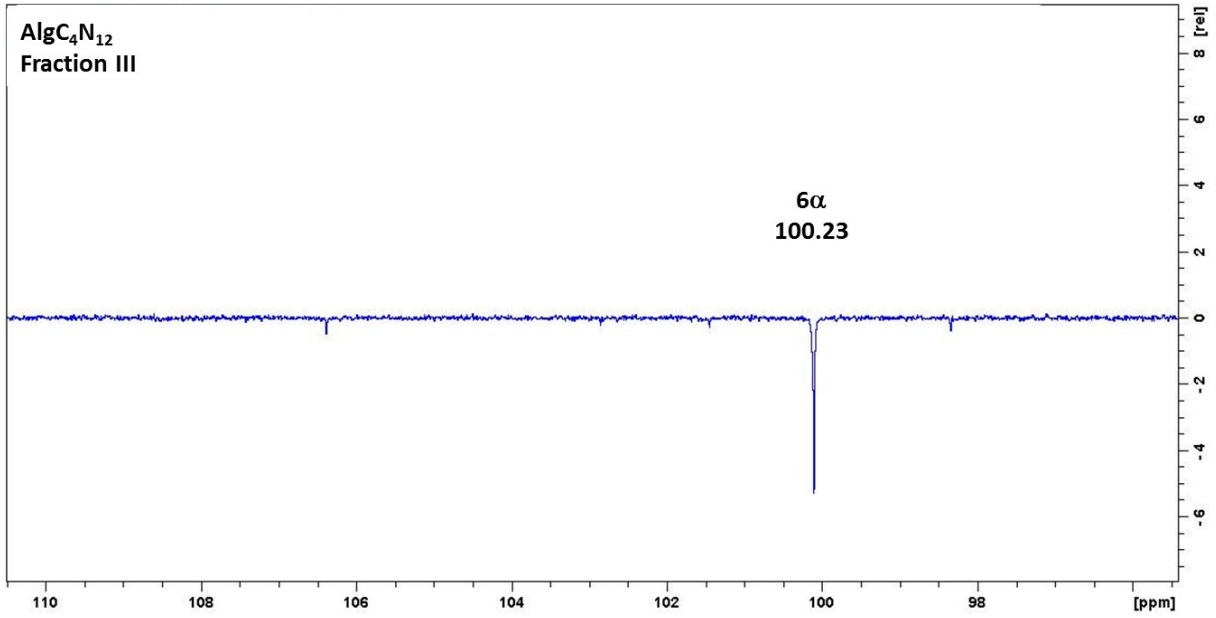


Fig.19b

**Fig.20** $^{1}$H NMR spectrum ($CDCl_3$) of a **Fraction IV** enriched in isomer **6β**, β-L-Gul*p* isolated after silica gel column chromatography of the **$AlgC_4N_{12}$** composition. In Fig.20a, full spectrum; in Fig.20b, zoom of the anomeric $^{1}$H area.

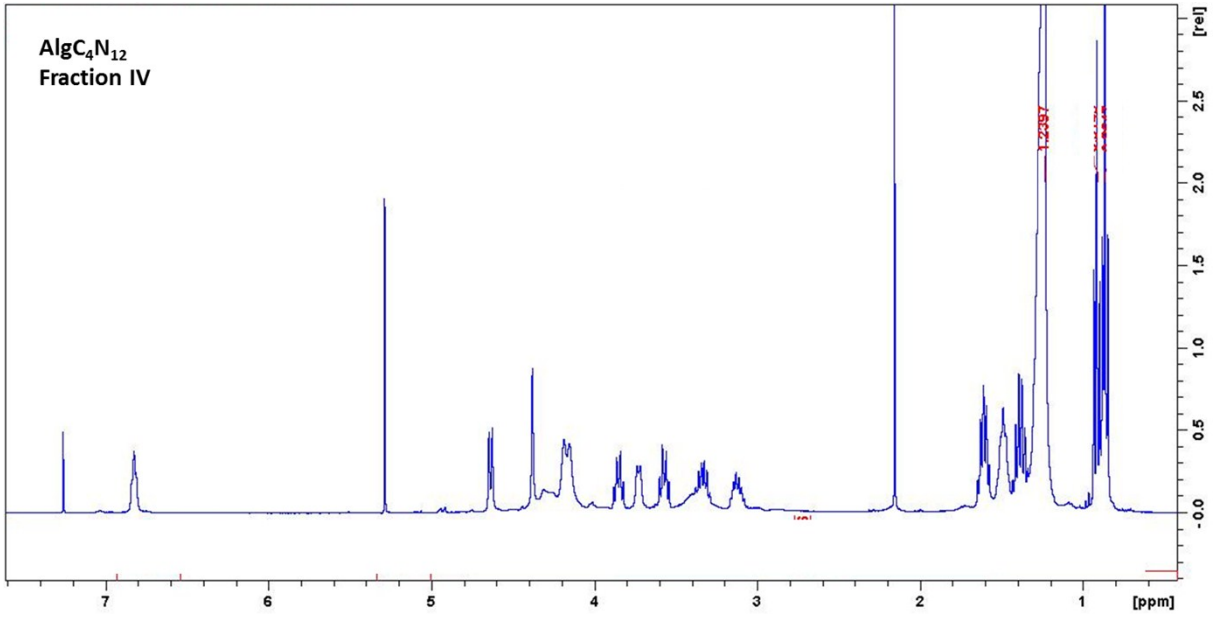


Fig.20a

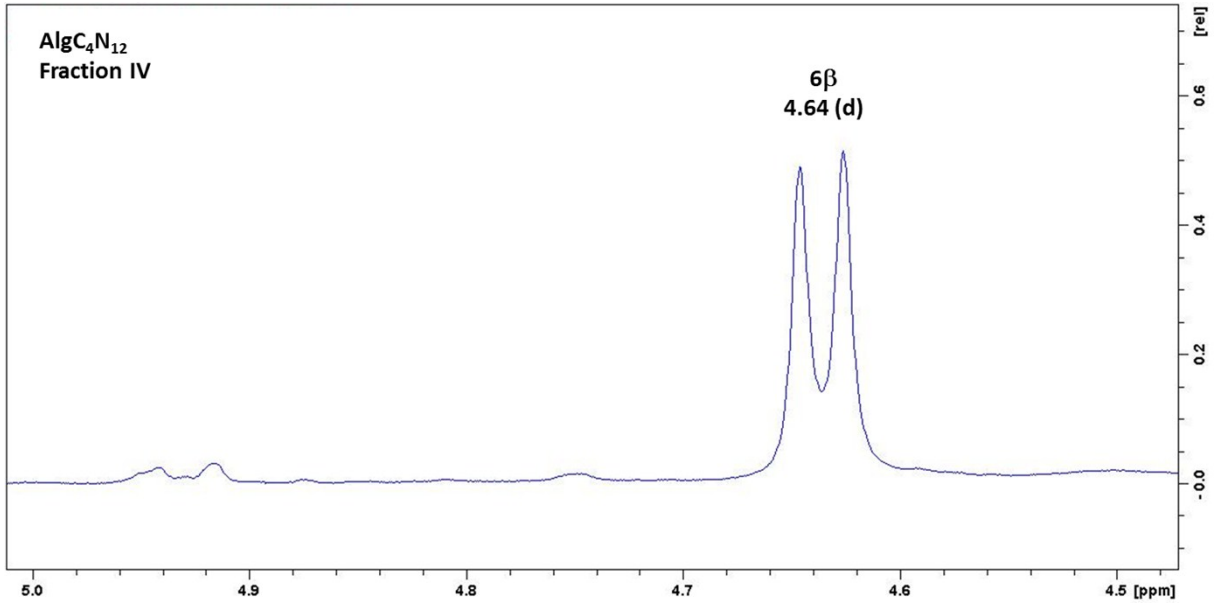


Fig.20b

**Fig.21** $^{13}C$ (JMod) NMR spectrum ($CDCl_3$) of a **Fraction IV** enriched in isomer **6β**, β-L-Gul*p* isolated after silica gel column chromatography of the **$AlgC_4N_{12}$** composition. In Fig.21a, full spectrum; in Fig.21b, zoom of the anomeric $^{13}C$ area.

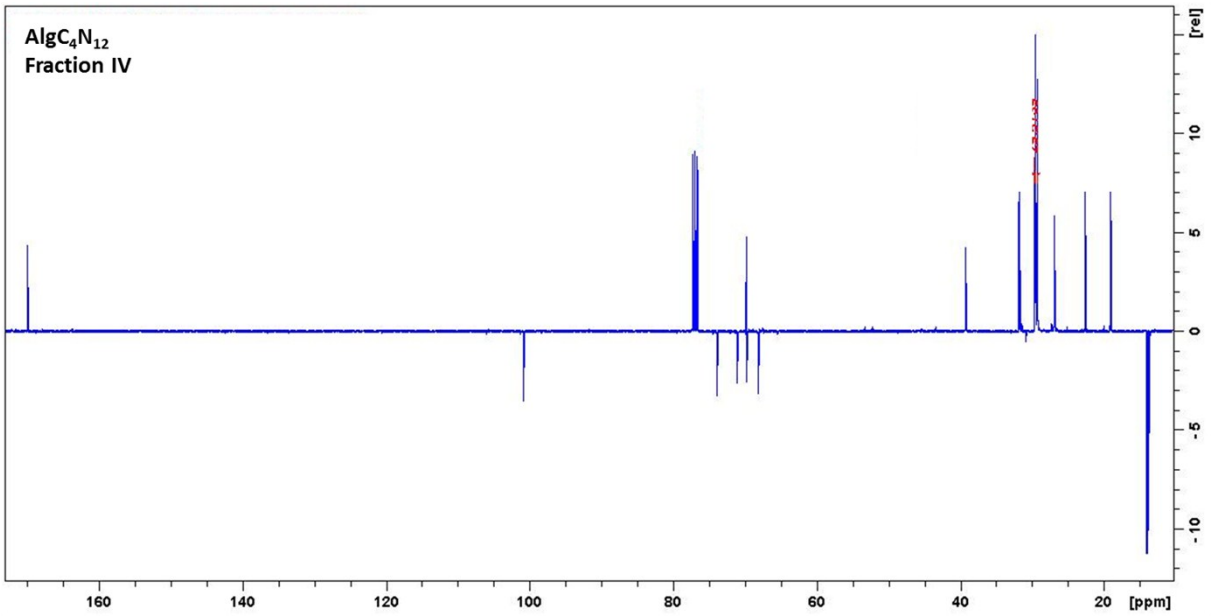


Fig.21a

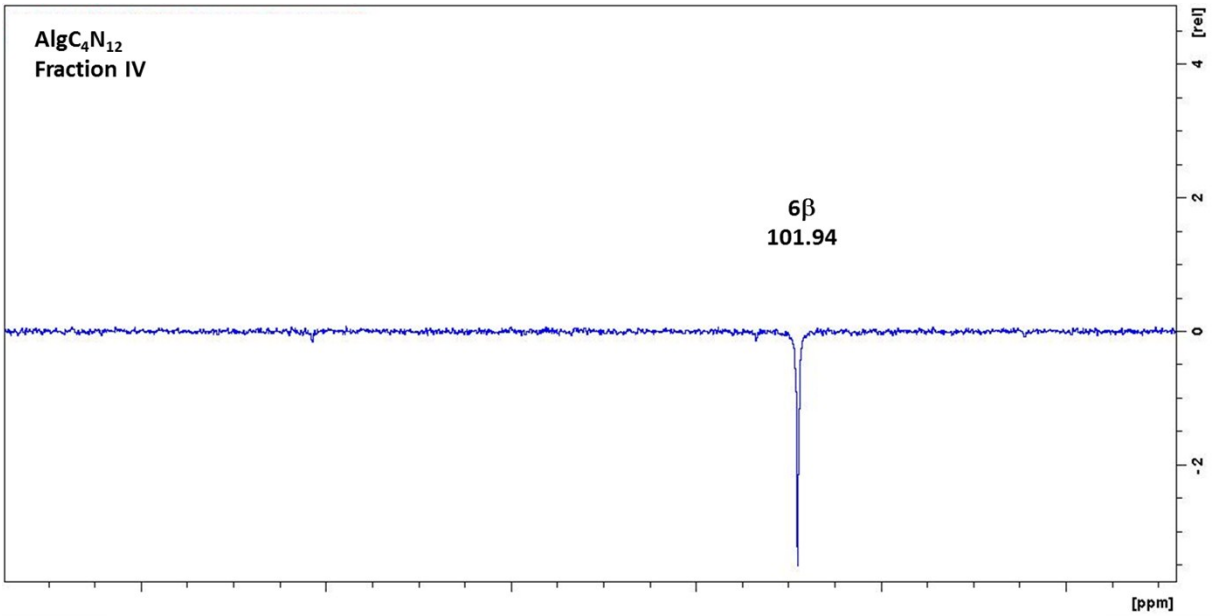


Fig.21b

**Fig.22** $^{1}$H NMR spectrum ($CDCl_3$) of a **Fraction I** enriched in isomer **9α**, α-D-Man*f* (major product) and isomers **5α**, α-L-Gul*f* and **11α**, α-D-Man*p* (minor products), isolated after silica gel column chromatography of the **$AlgC_4N_{18}$** composition.In Fig.22a, full spectrum; in Fig.22b, zoom of the anomeric $^{1}$H area.

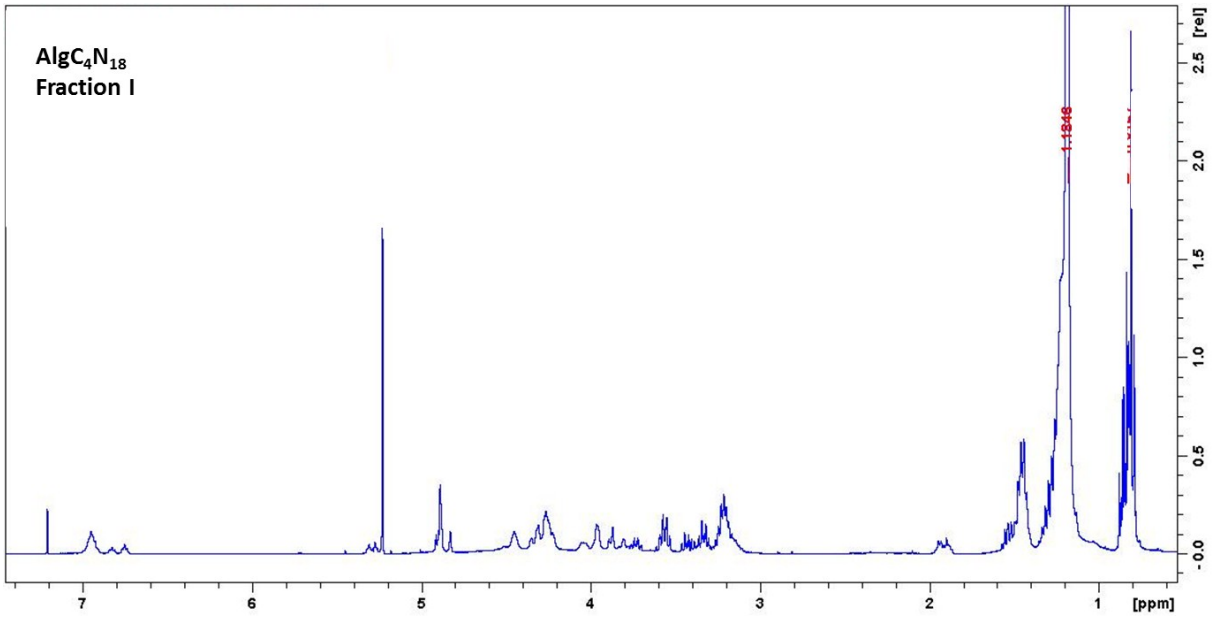


Fig.22a

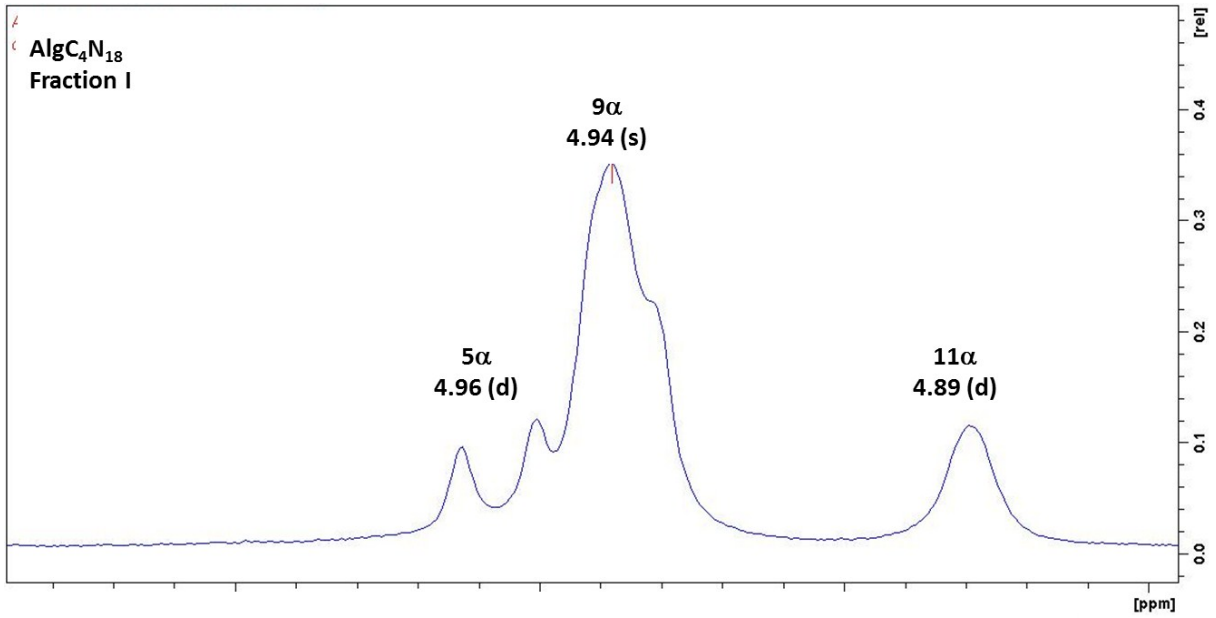


Fig.22b

**Fig.23** $^{13}C$ (JMod) NMR spectrum ($CDCl_3$) of a **Fraction I** enriched in isomer **9α**, α-D-Man*f* (major product) and isomers **5α**, α-L-Gul*f* and **11α**, α-D-Man*p* (minor products), isolated after silica gel column chromatography of the **$AlgC_4N_{18}$** composition. In Fig.23a, full spectrum; in Fig.23b, zoom of the anomeric $^{13}C$ area.

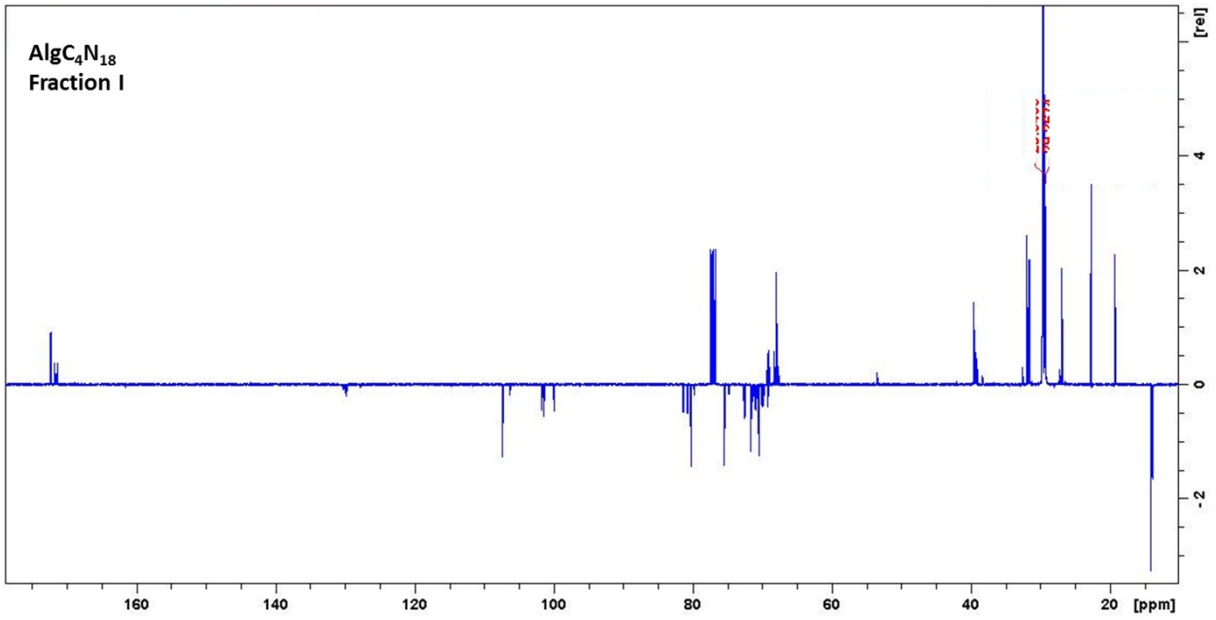


Fig.23a

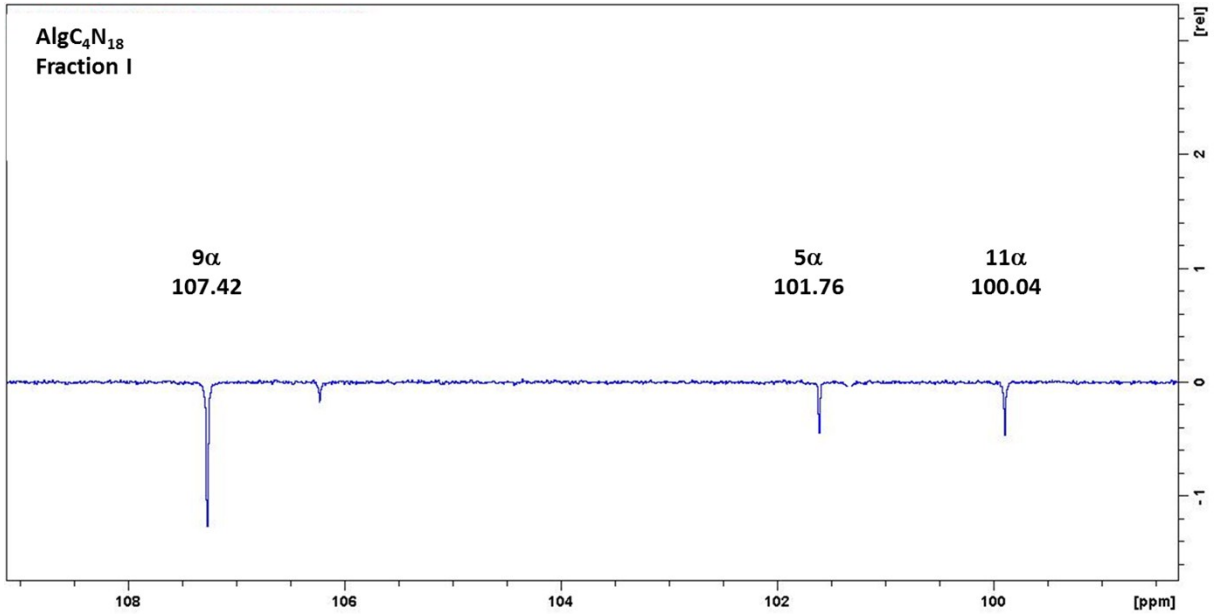


Fig.23b

**Fig.24** $^{1}$H NMR spectrum ($CDCl_3$) of a **Fraction II** enriched in isomer **7β**, β-L-Gul*p* (major product) and isomers **7α**, α-L-Gul*p* and **5β**, β-L-Gul*f* (minor products), isolated after silica gel column chromatography of the **$AlgC_4N_{18}$** composition.In Fig.24a, full spectrum; in Fig.24b, zoom of the anomeric $^{1}$H area.

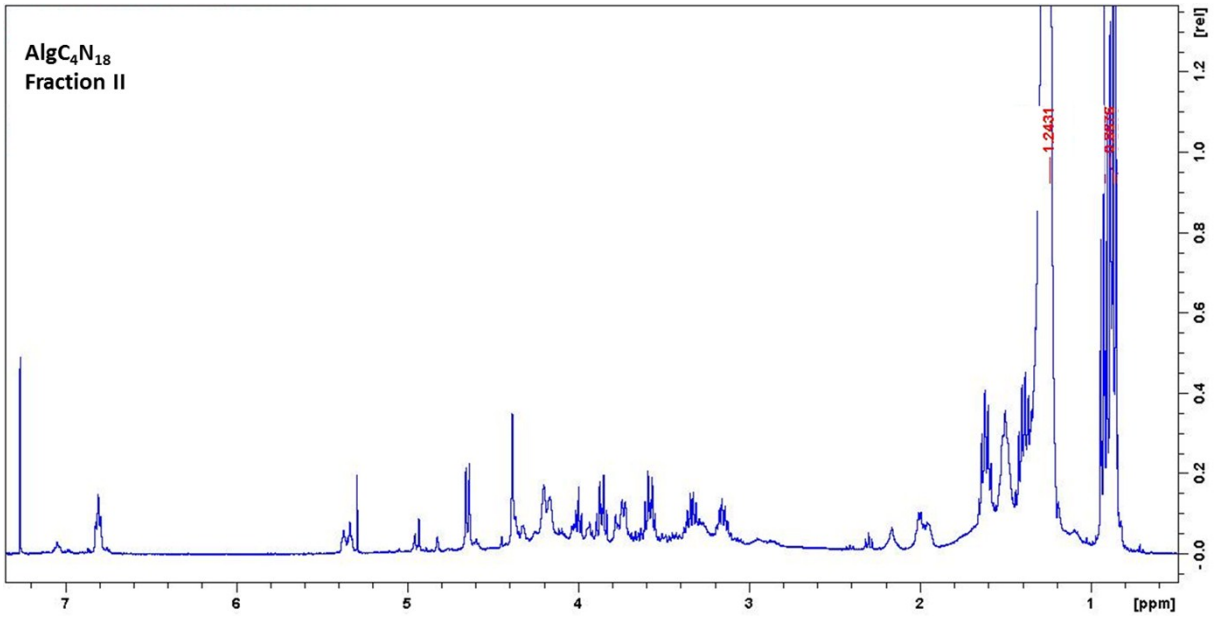


Fig.24a

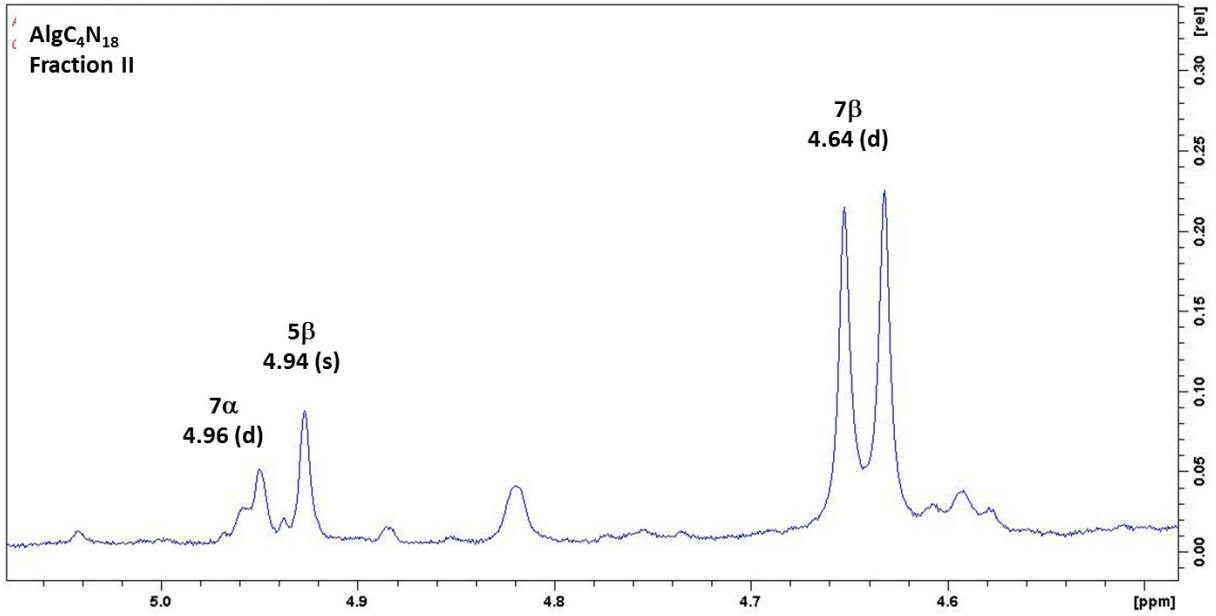


Fig.24b

**Fig.25** $^{13}C$ (JMod) NMR spectrum ($CDCl_3$) of **Fraction II** enriched in isomer **7β**, β-L-Gul*p* (major product) and isomers **7α**, α-L-Gul*p* and **5β**, β-L-Gul*f* (minor products), isolated after silica gel column chromatography of the **$AlgC_4N_{18}$** composition. In Fig.25a, full spectrum; in Fig.25b, zoom of the anomeric $^{13}C$ area.

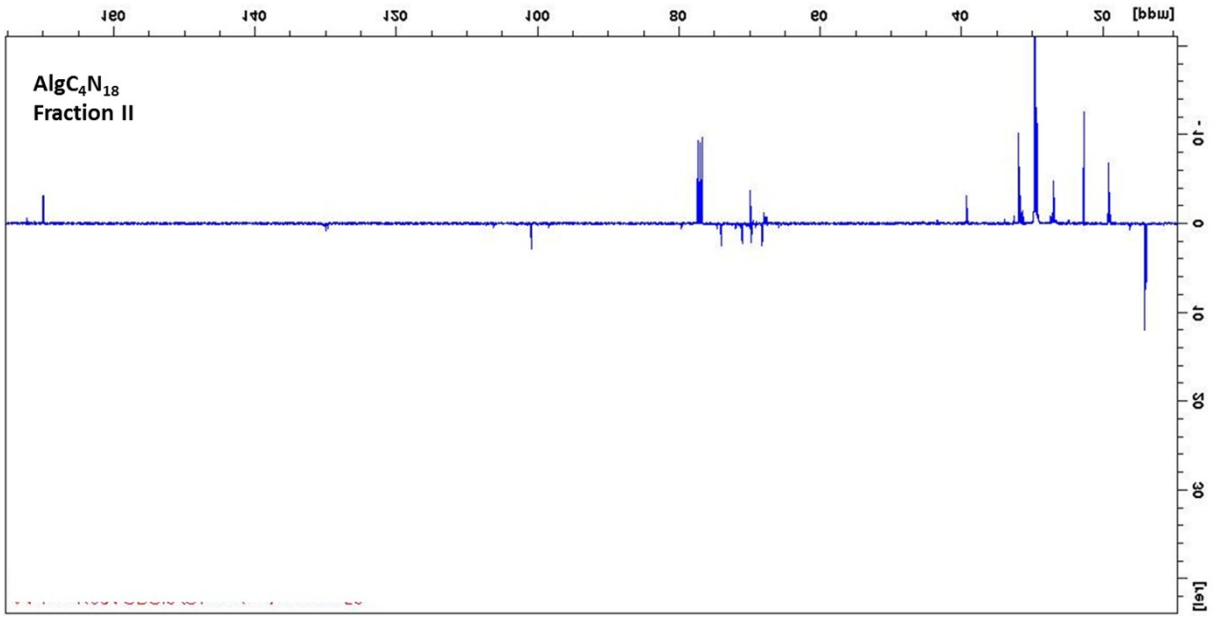


Fig.25a

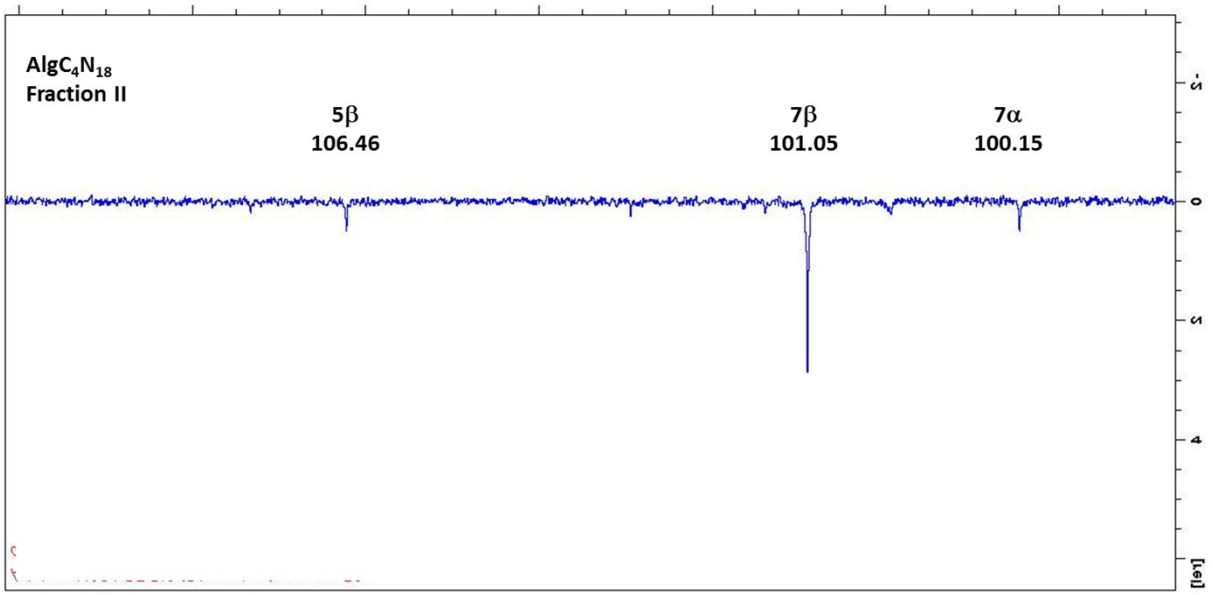


Fig.25b