Analysis of doxorubicin and cisplatin effect in MCF-7 breast cancer cells metabolism by ^{1}H HR-MAS NMR spectroscopy

Roberta M. Maria ([1]Embrapa Instrumentação) (PQ), Wanessa F. Altei ([2]UFSCar) (PQ),Heloisa S.S. Araujo ([2]UFSCar)(PQ) , Adriano D. Andricopulo ([3]IFSC)(PQ), Luiz A. Colnago ([1]Embrapa Instrumentação) (PQ)

*Corresponding author: Fax: +55 16 21072800
E-mail address: luiz.colnago@embrapa.br (L.A. Colnago)

[1]Embrapa Instrumentação, Rua XV de Novembro 1452, São Carlos, SP, Brazil 13560-970; [2]Laboratório de bioquímica e biologia molecular, departamento de ciências fisiológicas, UFSCar; [3]Laboratório de Química Medicinal e Computacional, IFSC, USP São Carlos.
Keywords: breast cancer cells, doxorubicin, cisplatin, metabolic profile, NMR.

Abstract

Doxorubicin and cisplatin are used in breast cancer treatment. However, the resistance of tumor cells to these drugs is a fundamental problem in tumor management. The nuclear magnetic resonance spectroscopy (NMR) has been used to investigate metabolic profile of cancer cells, especially ^{1}H HR-MAS technique, allowing a contribution for this area.

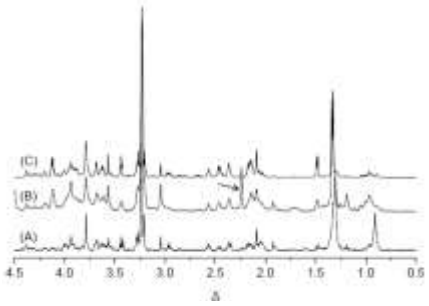
Introduction

Chemotherapy is use of medicines to treat diseases, such as cancer[1]. Doxorubicin[2] and cisplatin[3] are anticancer agents currently employed in breast cancer treatment. However, the cytotoxic effects of these drugs in cells can affect the life of patients and leads to an unsuccessful outcome in cancer treatment. In this way, the investigation of changes in cellular pathways caused by chemotherapy has become an attractive strategy in cancer drug development since the identification of biomarkers would allow therapy to be tailored on an individual patient providing information on drug intervention[4]. Recent advances in NMR techniques have permitted the metabolic profile analysis of cancer cells and tissues especially through ^{1}H HR-MAS technique. The advantages of this tool include rapid and accurate analysis, high reproducibility and minimal sample preparation[5]. ^{1}H HR-MAS NMR tool also includes non-destructive analysis that means particularly useful for detection of changes in membrane lipids *in vitro* analysis [6].

Results and Discussion

In present study, we have applied ^{1}H HR-MAS NMR spectroscopy to explore the metabolic profile of breast cancer cells MCF-7 after chemotherapy treatment. ^{1}H HR-MAS NMR spectra obtained with CPMG sequence showed metabolic profile with some difference in level of metabolites, for instance lactate, threonine, alanine, acetone, creatine, choline, phosphocholine and taurine. The fatty acid oxidation is an important mechanism for the survival of cancer cells when deprived of glucose[7]. Depending on the metabolic demand, fatty acids can either be used for macromolecular synthesis or oxidized in the mitochondria for energy production. The fatty acid oxidation results in ketone body production, for instance, acetone. Interestingly, we observed that only ^{1}H HR-MAS spectra obtained from MCF-7 treated with doxorubicin showed a signal to metabolite acetone (1.09 ± 0.97) suggesting a greater influence of this compound in energy production of MCF-7 cells when compared with cisplatin.

Figure 1. ^{1}H HR-MAS NMR spectra of breast cancer cell, MCF-7. Control (A), treated with doxorubicin (B) and treated with cisplatin (C). Acetone signal is highlighted.



Conclusion

In conclusion, ^{1}H HR-MAS NMR spectroscopy showed that a significant difference in metabolic profile exists between control breast cancer cells and breast cancer cells with chemotherapy treatment.

Aknowledgements

We would like to thanks Brazilian Agencies FAPESP grants # 2013/05128-5 and CNPq for financial support.

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