**Studying the effect of functional group and size of silica nanoparticles loaded with quercetin on their in vitro characteristics**

Study by
Lina Malik Ibraheem
Supervisor: Dr. Areen Khattabi

## Abstract

Mesoporous silica nanoparticles (SNs) possess unique properties, which make them ideal carriers for many therapeutic agents. Over the recent years, they have gained a wide popularity due to their uniform and tunable size as well as ease of surface functionalization in addition to their high drug loading capacity due to their large surface area to volume ratio. It is well known that both the size and the surface chemistry are important features that impact SNs' pharmaceutical applications and their in vitro characteristics. In this study, different surface functionalizations (propyl thiol SNs, propyl carboxylic acid SNs, propyl amine SNs and unmodified SNs) and two different sizes of propyl amine SNs (200 nm and less than 100 nm) were investigated. All SNs were loaded with quercetin, which is an anti – oxidative flavonoid with anti – cancer activity against different tumor types. The NPs' parameters were characterized using Dynamic Light Scattering (DLS) and their Drug Encapsulation Efficiency (EE) as well as Loading Capacity (LC) were measured using UV Spectrophotometer. Quercetin release rate was studied in phosphate buffer saline (pH 7.4, 37°C) and it's in vitro cytotoxicity toward HeLa cell was evaluated using MTT assay. The results of DLS showed that the mean particle size of all unloaded SNs are very close to their original size of 200 nm and less than 100 nm. Polydispersity (PD), an indicator for the heterogeneity of particle sizes distribution, for unloaded sample were found to be ranging from 0.27 for unmodified SNs to 0.32 for aminated SNs of less than 100 nm. The overall zeta potential was also measured for unloaded SNs with the highest value of -18.98 associated with carboxylated SNs .The mean particle sizes as well as zeta potential were all elevated after quercetin loading, suggesting successful loading of quercetin. Our results 21 demonstrated that quercetin encapsulation depends highly on the type of surface functional group of SNs. Aminated SNs showed the highest percentage followed by thiolated, unmodified and carboxylated SNs, respectively. A direct relation was observed between the in vitro drug release and the cytotoxicity studies. Thiolated SNs exhibited the fastest release rate and the highest percentage of in vitro cytotoxicity. The slowest quercetin release rate was observed with aminated SNs regardless of their size, which in turn showed the minimum cytotoxicity. In conclusion, surface modifications have a more pronounced effect on the in vitro properties of our studied SNs compared to the size effect. However, optimization of both surface functionalization and size of SNs will significantly contribute to more effective delivery systems with different in vitro characteristics.