**Supplementary material:**

**Supplementary Figure 1 A-C:** GO enrichment analysis displayed as bubble plot of the main biological process (**A**), molecular function (MF) (**B**) and cellular component (CC) (**C**) connected with cosmosiin and lung carcinoma. The bubble size and bubble color indicate enrichment gene number and p value respectively. A larger bubble size is an indicator of higher number of enriched genes and a redder color indicates a lower p value within that particular GO term which in turn reflects that GO term is strongly associated with the treatment of lung carcinoma than other GO terms.

**Supplementary** **Figure 2:** KEGG enrichment analysis for the identification of potential signalling pathways involved in the therapeutic targets of cosmosiin in the treatment of lung cancer. The sorting of the different metabolic pathways is done based on p values and the number of enriched genes which are indicated by color and size of the bubble respectively. The bubble size and bubble color are an indicator of enrichment gene and p value respectively.

**Supplementary** **Figure 3-A** and **3-B: (A)** gene mapping diagram highlights the key targets involved in the PD-L1 expression and PD-1 checkpoint pathway in cancer, indicating statistically significant findings due to its low p-value. **(B)** Similarly, the gene mapping diagram for the key targets associated with broader cancer pathways also reflects statistical significance, as evidenced by its low p-value.

**Supplementary Figure 4 A-E:** displays various representations of the target protein (NFKB1) along with the bound cosmosiin ligand, **A** shows the cavity site of the target protein PIK3R1 in ribbon model, **B** and **D** show the cartoon representation of the protein surface with clearly visible grooves and cavities along with bound cosmosiin ligand, C shows 2-D while **E** shows 3D-representation of the target protein along with bound cosmosiin ligand.

**Supplementary Figure 5 A-E:** displays various representations of the target protein (PI3KR1) along with the bound cosmosiin ligand, **A** shows the cavity site of the target protein PIK3R1 in ribbon model, **B** and **D** show the cartoon representation of the protein surface with clearly visible grooves and cavities along with bound cosmosiin ligand, C shows 2-D while **E** shows 3D-representation of the target protein along with bound cosmosiin ligand.

**Supplementary Figure 6:** Results of the MTT colorimetric assay indicating a remarkable, dose and time-dependent inhibition of cell viability induced by increasing doses of cosmosiin in A-549 human lung carcinoma cells. Data of individual triplicate experiments were presented as mean± SD, \* p<0.05, \*\* p<0.01 as statistically significant with respect to the control.

**Supplementary Figure 7:** Results of the annexin V assay showing the effect of increasing doses of cosmosiin on the early and late apoptotic cell percentage, it indicates that increasing doses of cosmosiin also increases the percentage of both early and late apoptotic cells.

**Supplementary Figure 8-A:** Results of the transwell migration assay exhibiting the effect of increasing doses of cosmosiin on the cell migration tendency of A-549 human lung cancer cells. As can be seen, a dose-dependent effect on cell migration suppression was observed especially at 80 µM dose.

**Supplementary Figure 8-B:** Quantitative estimation of the effect of different doses of cosmosiin on the cell migration inhibition of A-549 human lung cancer cells. Data of individual triplicate experiments were presented as mean± SD, \* p<0.05 as statistically significant with respect to the control. The effect was much more pronounced at 40 and 80 µM concentration.

**Supplementary Figure 9:** Western blot analysis showing the downregulation of NFKB1 and PIK3R1 protein expressions in response to cosmosiin treatment. ꞵ-actin was used as a control.