Human serum albumin nanoparticles: synthesis, optimization and immobilization with antituberculosis drugs

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Formulations of HSA-INH-RIF NPs using central composite design and their evaluation parameters

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Response 1 | Response 2 | Response 3 |
| Std | Run | A:[HSA] | B:[Urea] | C:[L-cystein] | D:[INH] | E:[Rif] | Size | Loading degree  of INH | Loading degree  of RIF |
|  |  | mg/mL | mol/L | mg/mL | mg/mL | mg/mL | nm | % | % |
| 4 | 1 | 1 | 1 | 1 | -1 | -1 | 351,6 | 78 | 25 |
| 11 | 2 | -1 | -1 | -1 | -1 | -1 | 216,5 | 22 | 22 |
| 1 | 3 | 1 | 1 | -1 | 1 | -1 | 233,2 | 22 | 29 |
| 5 | 4 | 1 | 1 | -1 | -1 | 1 | 136,3 | 22 | 22 |
| 17 | 5 | 0 | 0 | 1,49535 | 0 | 0 | 304,7 | 21 | 42 |
| 9 | 6 | 1 | -1 | 1 | -1 | 1 | 134,2 | 23 | 23 |
| 7 | 7 | -1 | -1 | 1 | 1 | 1 | 239,6 | 30 | 19 |
| 3 | 8 | -1 | 1 | 1 | -1 | 1 | 152,8 | 32 | 53 |
| 12 | 9 | -1,49535 | 0 | 0 | 0 | 0 | 327,3 | 39 | 20 |
| 21 | 10 | 0 | 0 | 0 | 0 | 1,49535 | 232,1 | 90 | 18 |
| 19 | 11 | 0 | 0 | 0 | 1,49535 | 0 | 191,4 | 26 | 26 |
| 15 | 12 | 0 | 1,49535 | 0 | 0 | 0 | 174,9 | 51 | 51 |
| 14 | 13 | 0 | -1,49535 | 0 | 0 | 0 | 134,2 | 23 | 23 |
| 8 | 14 | -1 | 1 | -1 | 1 | 1 | 191,6 | 13 | 7 |
| 18 | 15 | 0 | 0 | 0 | -1,49535 | 0 | 204,7 | 7 | 7 |
| 16 | 16 | 0 | 0 | -1,49535 | 0 | 0 | 243,2 | 39 | 39 |
| 26 | 17 | 0 | 0 | 0 | 0 | 0 | 156,1 | 21 | 21 |
| 22 | 18 | 0 | 0 | 0 | 0 | 0 | 184,2 | 19 | 20 |
| 13 | 19 | 1,49535 | 0 | 0 | 0 | 0 | 336,6 | 16 | 16 |
| 25 | 20 | 0 | 0 | 0 | 0 | 0 | 215,5 | 23 | 26 |
| 2 | 21 | 1 | -1 | 1 | 1 | -1 | 231,4 | 7 | 15 |
| 10 | 22 | -1 | 1 | 1 | 1 | -1 | 253,1 | 22 | 22 |
| 23 | 23 | 0 | 0 | 0 | 0 | 0 | 159,6 | 12 | 6 |
| 20 | 24 | 0 | 0 | 0 | 0 | -1,49535 | 177,5 | 26 | 8 |
| 6 | 25 | 1 | -1 | -1 | 1 | 1 | 289,5 | 51 | 30 |
| 24 | 26 | 0 | 0 | 0 | 0 | 0 | 221,2 | 17 | 17 |

### ANOVA for Quartic model (Aliased)

**Response 1: Size**  
Transform: Power  
Lambda: 2,5, Constant: 0

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Source** | **Sum of Squares** | **df** | **Mean Square** | **F-value** | **p-value** |  |
| **Model** | 8,643E+12 | 21 | 4,116E+11 | 10,52 | 0,0171 | significant |
| A-[HSA] | 9,887E+09 | 1 | 9,887E+09 | 0,2528 | 0,6415 |  |
| B-[Urea] | 1,919E+10 | 1 | 1,919E+10 | 0,4907 | 0,5222 |  |
| C-[L-cystein] | 2,438E+11 | 1 | 2,438E+11 | 6,23 | 0,0670 |  |
| D-[INH] | 4,295E+09 | 1 | 4,295E+09 | 0,1098 | 0,7570 |  |
| E-[Rif] | 8,038E+10 | 1 | 8,038E+10 | 2,06 | 0,2250 |  |
| AB | 6,515E+11 | 1 | 6,515E+11 | 16,66 | 0,0151 |  |
| AC | 3,471E+11 | 1 | 3,471E+11 | 8,87 | 0,0408 |  |
| AD | 6,986E+11 | 1 | 6,986E+11 | 17,86 | 0,0134 |  |
| AE | 6,106E+10 | 1 | 6,106E+10 | 1,56 | 0,2796 |  |
| BC | 4,291E+11 | 1 | 4,291E+11 | 10,97 | 0,0296 |  |
| BD | 3,472E+11 | 1 | 3,472E+11 | 8,88 | 0,0408 |  |
| BE | 1,482E+09 | 1 | 1,482E+09 | 0,0379 | 0,8552 |  |
| CD | 2,431E+11 | 1 | 2,431E+11 | 6,21 | 0,0673 |  |
| CE | 1,751E+10 | 1 | 1,751E+10 | 0,4478 | 0,5400 |  |
| DE | 3,901E+11 | 1 | 3,901E+11 | 9,97 | 0,0342 |  |
| A² | 3,253E+12 | 1 | 3,253E+12 | 83,19 | 0,0008 |  |
| B² | 5,302E+10 | 1 | 5,302E+10 | 1,36 | 0,3090 |  |
| C² | 8,520E+11 | 1 | 8,520E+11 | 21,78 | 0,0095 |  |
| D² | 4,154E+09 | 1 | 4,154E+09 | 0,1062 | 0,7608 |  |
| E² | 2,091E+10 | 1 | 2,091E+10 | 0,5347 | 0,5052 |  |
| ABC | 5,223E+11 | 1 | 5,223E+11 | 13,36 | 0,0217 |  |
| ABD | 0,0000 | 0 |  |  |  |  |
| ABE | 0,0000 | 0 |  |  |  |  |
| ACD | 0,0000 | 0 |  |  |  |  |
| ACE | 0,0000 | 0 |  |  |  |  |
| ADE | 0,0000 | 0 |  |  |  |  |
| BCD | 0,0000 | 0 |  |  |  |  |
| BCE | 0,0000 | 0 |  |  |  |  |
| BDE | 0,0000 | 0 |  |  |  |  |
| CDE | 0,0000 | 0 |  |  |  |  |
| A²B | 0,0000 | 0 |  |  |  |  |
| A²C | 0,0000 | 0 |  |  |  |  |
| A²D | 0,0000 | 0 |  |  |  |  |
| A²E | 0,0000 | 0 |  |  |  |  |
| AB² | 0,0000 | 0 |  |  |  |  |
| AC² | 0,0000 | 0 |  |  |  |  |
| AD² | 0,0000 | 0 |  |  |  |  |
| AE² | 0,0000 | 0 |  |  |  |  |
| B²C | 0,0000 | 0 |  |  |  |  |
| B²D | 0,0000 | 0 |  |  |  |  |
| B²E | 0,0000 | 0 |  |  |  |  |
| BC² | 0,0000 | 0 |  |  |  |  |
| BD² | 0,0000 | 0 |  |  |  |  |
| BE² | 0,0000 | 0 |  |  |  |  |
| C²D | 0,0000 | 0 |  |  |  |  |
| C²E | 0,0000 | 0 |  |  |  |  |
| CD² | 0,0000 | 0 |  |  |  |  |
| CE² | 0,0000 | 0 |  |  |  |  |
| D²E | 0,0000 | 0 |  |  |  |  |
| DE² | 0,0000 | 0 |  |  |  |  |
| A³ | 0,0000 | 0 |  |  |  |  |
| B³ | 0,0000 | 0 |  |  |  |  |
| C³ | 0,0000 | 0 |  |  |  |  |
| D³ | 0,0000 | 0 |  |  |  |  |
| E³ | 0,0000 | 0 |  |  |  |  |
| ABCD | 0,0000 | 0 |  |  |  |  |
| ABCE | 0,0000 | 0 |  |  |  |  |
| ABDE | 0,0000 | 0 |  |  |  |  |
| ACDE | 0,0000 | 0 |  |  |  |  |
| BCDE | 0,0000 | 0 |  |  |  |  |
| A²B² | 0,0000 | 0 |  |  |  |  |
| A²BC | 0,0000 | 0 |  |  |  |  |
| A²BD | 0,0000 | 0 |  |  |  |  |
| A²BE | 0,0000 | 0 |  |  |  |  |
| A²C² | 0,0000 | 0 |  |  |  |  |
| A²CD | 0,0000 | 0 |  |  |  |  |
| A²CE | 0,0000 | 0 |  |  |  |  |
| A²D² | 0,0000 | 0 |  |  |  |  |
| A²DE | 0,0000 | 0 |  |  |  |  |
| A²E² | 0,0000 | 0 |  |  |  |  |
| AB²C | 0,0000 | 0 |  |  |  |  |
| AB²D | 0,0000 | 0 |  |  |  |  |
| AB²E | 0,0000 | 0 |  |  |  |  |
| ABC² | 0,0000 | 0 |  |  |  |  |
| ABD² | 0,0000 | 0 |  |  |  |  |
| ABE² | 0,0000 | 0 |  |  |  |  |
| AC²D | 0,0000 | 0 |  |  |  |  |
| AC²E | 0,0000 | 0 |  |  |  |  |
| ACD² | 0,0000 | 0 |  |  |  |  |
| ACE² | 0,0000 | 0 |  |  |  |  |
| AD²E | 0,0000 | 0 |  |  |  |  |
| ADE² | 0,0000 | 0 |  |  |  |  |
| B²C² | 0,0000 | 0 |  |  |  |  |
| B²CD | 0,0000 | 0 |  |  |  |  |
| B²CE | 0,0000 | 0 |  |  |  |  |
| B²D² | 0,0000 | 0 |  |  |  |  |
| B²DE | 0,0000 | 0 |  |  |  |  |
| B²E² | 0,0000 | 0 |  |  |  |  |
| BC²D | 0,0000 | 0 |  |  |  |  |
| BC²E | 0,0000 | 0 |  |  |  |  |
| BCD² | 0,0000 | 0 |  |  |  |  |
| BCE² | 0,0000 | 0 |  |  |  |  |
| BD²E | 0,0000 | 0 |  |  |  |  |
| BDE² | 0,0000 | 0 |  |  |  |  |
| C²D² | 0,0000 | 0 |  |  |  |  |
| C²DE | 0,0000 | 0 |  |  |  |  |
| C²E² | 0,0000 | 0 |  |  |  |  |
| CD²E | 0,0000 | 0 |  |  |  |  |
| CDE² | 0,0000 | 0 |  |  |  |  |
| D²E² | 0,0000 | 0 |  |  |  |  |
| A³B | 0,0000 | 0 |  |  |  |  |
| A³C | 0,0000 | 0 |  |  |  |  |
| A³D | 0,0000 | 0 |  |  |  |  |
| A³E | 0,0000 | 0 |  |  |  |  |
| AB³ | 0,0000 | 0 |  |  |  |  |
| AC³ | 0,0000 | 0 |  |  |  |  |
| AD³ | 0,0000 | 0 |  |  |  |  |
| AE³ | 0,0000 | 0 |  |  |  |  |
| B³C | 0,0000 | 0 |  |  |  |  |
| B³D | 0,0000 | 0 |  |  |  |  |
| B³E | 0,0000 | 0 |  |  |  |  |
| BC³ | 0,0000 | 0 |  |  |  |  |
| BD³ | 0,0000 | 0 |  |  |  |  |
| BE³ | 0,0000 | 0 |  |  |  |  |
| C³D | 0,0000 | 0 |  |  |  |  |
| C³E | 0,0000 | 0 |  |  |  |  |
| CD³ | 0,0000 | 0 |  |  |  |  |
| CE³ | 0,0000 | 0 |  |  |  |  |
| D³E | 0,0000 | 0 |  |  |  |  |
| DE³ | 0,0000 | 0 |  |  |  |  |
| A⁴ | 0,0000 | 0 |  |  |  |  |
| B⁴ | 0,0000 | 0 |  |  |  |  |
| C⁴ | 0,0000 | 0 |  |  |  |  |
| D⁴ | 0,0000 | 0 |  |  |  |  |
| E⁴ | 0,0000 | 0 |  |  |  |  |
| **Pure Error** | 1,564E+11 | 4 | 3,911E+10 |  |  |  |
| **Cor Total** | 8,800E+12 | 25 |  |  |  |  |

Factor coding is **Coded**.  
Sum of squares is **Type III - Partial**

The **Model F-value** of 10,52 implies the model is significant. There is only a 1,71% chance that an F-value this large could occur due to noise.

**P-values** less than 0,0500 indicate model terms are significant. In this case AB, AC, AD, BC, BD, DE, A², C², ABC are significant model terms. Values greater than 0.1000 indicate the model terms are not significant. If there are many insignificant model terms (not counting those required to support hierarchy), model reduction may improve your model.

 

    

 