

## SPARQL Query Formulation through BioFed Interface

Availability: <http://vmurq09.deri.ie:8007/>

With the Standard interface, the user can formulate basic SPARQL query. Whereas the interface can process simple as well as complex federated queries over Life Science Linked Open Data Cloud (LS-LOD).

**Example 1: A biologist interested to query geneName, Name and Protein Sequence for enzymes**

```
SELECT distinct * WHERE
{
?x a <http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugbank/enzymes> .
?x <http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugbank/geneName> ?y .
?x <http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugbank/name> ?z .
?x <http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugbank/proteinSequence> ?n .
}
limit 10
```

In order to make such query the user first selects the concept “enzymes” from the “Make Selection” drop box (Figure 1).

The screenshot displays the BioFed interface with the following elements:

- Header:** BioFed: Federated Query Processing over Life Sciences Linked Open Data
- Query Builder Type:** Standard (selected)
- Query Builder:** A section containing a dropdown menu with "-- Make selection --" and a "Reset Query" button.
- Query Text Area:** A text box containing the SPARQL query: `SELECT * WHERE { }`
- Output:** A dropdown menu set to "Display the result" and an "Execute Query" button.
- Query Status:** A link labeled "show".
- Query Result:** A section header for the results.

Figure 1: BioFed main interface

After selecting the concept “enzymes”, he selects “geneName”, “Name” and “Protein Sequence” properties from the “Make Selection” drop box that will now show various properties associated

with the concept “enzymes” and add them in query text area through “Add to Query” button. User has to change/chose different variable names himself e.g in our example we choose ?y, ?z, ?n. All must be different (Figure 2).

```
SELECT distinct * WHERE {
?x a <http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugbank/enzymes> .
?x <http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugbank/geneName> ?y .
?x <http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugbank/name> ?z .
?x <http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugbank/proteinSequence> ?n .
}
limit 10
```

Figure 2: SPARQL query generation: "give me geneName, Name and Protein Sequence for enzymes " from BioFed interface

After making the query, the user can add “distinct”, “Filter”, “Limit” and “Order By” clause by himself. In our example we use “distinct” and “limit” our answers by 10 (Figure 3). By clicking on “Execute Query”, the results will be displayed (Figure 3).

x	y	z	n
http://www4.wiwiss.fu-berlin.de/drugbank/resource/enzymes/2	GLUL	Glutamine Synthetase	>sp P15104 GLNA_HUMAN Glutamine synthetase (EC 6.3.1.2) TTSASSHLNKGKQVYMSLPQGEKVQAMYIWDGTGEGLRCKTRTLDSEPKCVEELPEWN FDGSSSTLQSEGSNSDMYLVPAAMFRDPFRKDPNKLVLCEVFKYNNRPAETNLRHTCKRIM DMVSNQHPWFGMEQEYTLNGTDSHPFGWPSNGFPSPQYPCVCGADRAYGRDVEAHYR ACLYAGVKIAGTNAEVMPAQWFEQJGCEGISMGDHLWVARFILHRVCEDFGVIATFDPK PIPGWNGAGCHTTFSTKAMREENGKYIEAEIKLSKRHQYHIRAYDPKGLDNARRLT GFHETSININDFSAGVANRSASIRIPRTVQGEKKGFEDRPSANCDPFSVTEALIRTCLL NETGDEPFQYKN
http://www4.wiwiss.fu-berlin.de/drugbank/resource/enzymes/26	CYP2C9	Cytochrome P450 2C9 (CYP2C9)	>sp P11712 CP2C9_HUMAN Cytochrome P450 2C9 (EC 1.14.13.80) MDSLVLVLCCLLLSLWRQSSGRGKLPDPPTLPIVIGNILQIGKDISKSLTNLSKV YGPVFTLYFLGKPIVVLHGVEAVKEALIDLGEEFSGRIFPLAERANRFGIVFVSNKWW KEIRFSLMTRNFGMGKRSIEDRVQEEARCLVEELRKTAKSPCDPTILGCAPCNVICS IIFHKRFDYKDQQLNLMEKLNENIKLSSPWIQICNNFSPIDYFPGTHNKLKNVAFM KSYILEKVKHQESMDMNNPQDFIDCFLMKMEKEKHNQPSSEFTIESLENTAVDLFGAGTE TTSTTLRYALLLLKHPEVTAKVQEEIERVIGRNRSPCMQDRSHMPYTDVAVHEVQRYID LLPTSLPHAVTCDIKFRNYLIPKGTTLISLTVLHDNKEFPNPEMFDPIHFLDEGGNFK KSKYFMPFSGAKRJCVCGEALAGMELFLFSLTILQFNKLSLVDPKNLDTPVAVNGFASVP PFYQLCFIVP
http://www4.wiwiss.fu-berlin.de/drugbank/resource/enzymes/28	XDH	Xanthine dehydrogenase/oxidase	>sp P47989 XDH_HUMAN Xanthine dehydrogenase/oxidase TADKLVFVNGRKKVVEKNADPETTLAYLRRKLGSLGKLGCGEGGCGACTVMSKYDRL QNKIVHFSANACLAPICSLHHVAVTTVEGIGSTKTRLHPVQERIAKSHGSCQGFCTPQIV MSMYTLRNOPEPTMEEIENAFQSNLRCCTCYRPLLQGFRTFARDGGCCGGDGNPNCCM NQKKDHSVLSLSPFLKPEEFTPLDPTQEPFPELLRLKDTPRKQLRFEGERVTWIOAST LKELLDLKAQHPDAKLVVNGTEIGEMFKNMLFPIVCPAWIPELNSVEHGGPDSFGA ACPLSIVEKTLVDAVAKLPAQKTEVFRVLEQLRFAGKQVKSVASVGGNIITASPIDL NPVFMASGAKTLVSRGTRRTVQMDHFFPGYRKTLLSPEILLSTIEIPYSREGEYSAF

Figure 3: Results display through BioFed

The “Output” drop box contains two options “Display the results” and “Download the results”.

After selecting “Display the results” option, the user will click “Execute Query” button to display the results (Figure 3).

The user can also execute and download the query results in various formats such as CSV, JSON, XML, Text, TSV and Turtle (Figure 4 and Figure 5).

```
SELECT distinct * WHERE {
?x a <http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugbank/enzymes> .
?x <http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugbank/geneName> ?y .
?x <http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugbank/name> ?z .
?x <http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugbank/proteinSequence> ?n .
}
limit 10
```

Output:  Format:  FileName:  .CSV

**Query Status** [show](#)

**Query Result**

10 results displayed

Figure 4: Results display in different formats

x	y	z	n
1			TTSSASHLNKGIKQVYMSLPQGEKVGQAMYIWDGTGEGLRCKRTL DSEPKVCEELPEWN FDGSSTLQSEGSNDMYLVPAAFRDPRKDPNKLVLCEVFKYRRAETNLRIHCKRIM DMVSNQHPWFMGEQYELMGTGDGHPGWPNSNGFGPGQPPYCVGADRAYGRDVEAHYR ACLYAGVKIAGTNAEVMPAQWFEQIGCEGSMGDHLWVARFHLRVCEDFGVATFDPK PIPGNWNWAGCHTNTFTKAMREENGKYIEAEIKLSKHQHIRAYDPKGLDNARRLT GFHETSININQFSAVANRSASIRIPRTVGGQKGYEDRRRPSANCDPPSVTEALIRITCLL NETGDEPFQYKN
2	http://www4.wiwiss.fu-berlin.de/drugbank/resource/enzymes/2	GLUL	Glutamine Synthetase  >sp P11712 CP2C9_HUMAN Cytochrome P450 2C9 (EC 1.14.13.80) MDSLVLVLCISCLLLSLWRQSSGRGKLPQPTPLVIGNILQIGIKDISKSLTNLSKV YGVVFLYFLGKPIVVLHGVEAVKEALIDLGEESGRGIFPLAERANRGGIVGVSNGKQW KEIRRFSLMLRNFIMGKRSIEDRVOQEARCLVEELRCKTASCPDPTFLGAPCNVIC IIFHRFDYKQDFLNLMEKLINEKILSSPWIQCNFNFSPIIDYFGTHNKLKKNVAFM KSYILEKVEHQESMDMNPQDFIDCFIMMMEKEHNPSEFTLESLENTAVDLFGAGTE TTSITLRYALLLLLHREVEVAKVQEEIEEIVGRVRSFCQGBISHHMYTDAVHREVGRIYD LLPSTLPHAVTCOKFRVYLPKGTITLSSLSLHDKNEFPNPEMFDPHHFDGEGNK KSKYFMPFSAGRRCVGEALAGMELFLFTLSLQNFNLKSLVDPKNDLTPVNVGFASVP PFYQLCFIPV
3	http://www4.wiwiss.fu-berlin.de/drugbank/resource/enzymes/26	CYP2C9	Cytochrome P450 2C9 (CYP2C9)  TADKLVFPVNGRNVKKNADPETTLAYLRRLGLSGTKLGGGCGGACTVMLSKYDRL QNKVYFSANACLPICSLHHVAVTTVEGISTKTRLHPVQERIAKSHGSCGCGCTPGIV MSMYTLRINQPEPTMEEIENAFQNLCRCTGYRPLQGRFTRFARDGGCGDGNPNCCM NQKQDHSVLSPLFKPEEFTPLDPTQEPFPELRLKDTFRKQLRFEGERVTWQAST LKELLDKAQHPDAKLVGNTEIGEMKFNMLFPMIVCPAWIPELNSVEHGPDGISFGA ACPLSIVEKTLVDVAVALPAQKTEVFRGVLQLRWFAGQKQKSVASVGGNIITSPISDL NPVFMASGAKLTLVSRGTRRTVQMDHFTFPGYRKTLLSPEELLSIEIPYREGYISAF KQASREDDAAVYSGMRVLKPGTTEVQELALCYGGMANRTSALKTRQRLSKLWKEE LLDQVCAGLAEELHPPAPGGMVDFRCTLTSFFRFFYLVCKLQENLEDCGKLDP TASATLFDKPPADVQLGQEVPKQSEEDMVGRLPHLAADMQASGALYCCDPIRYE NELSLRLVTSRAHAKSDTSEAKVPGVFCISADDPVGSNTIGCNDETVAKDKV TCVGHIGAVADTPEHTQRAAQGWKTYEELPAITIEDAKNNSYFPELKEKGLK KGFSEADNVSGEYIGGQEHFYLETHTIAPVKGAGEGEMELFVSTQNTMKTQSFVAKML
4	http://www4.wiwiss.fu-berlin.de/drugbank/resource/enzymes/28	XDH	Xanthine dehydrogenase/oxidase

Figure 5: Downloaded results in CSV format

## Example 2: Simple and Complex SPARQL query execution through BioFed

Instead of formulating the basic query from drop down menu if an expert user wants to execute any other query he can run such queries as well.

Different Simple and Complex queries are presented in the paper and listed at

<http://srvgal78.derl.ie/BioFed/queries.html>

Let us consider Simple Query 2 and copy it to the interface and execute the query

**SQL2: Find all the drug description and chemical equations of reactions related to drugs from category Cathartics.**

```
PREFIX drugcategory: <http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugcategory/>
PREFIX drugbank: <http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugbank/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX kegg: <http://bio2rdf.org/ns/kegg#>
SELECT ?drugDesc ?cpd ?equation WHERE {
?drug drugbank:drugCategory drugcategory:cathartics .
?drug drugbank:keggCompoundId ?cpd .
?drug drugbank:description ?drugDesc .
?enzyme kegg:xSubstrate ?cpd .
?enzyme rdf:type kegg:Enzyme .
?reaction kegg:xEnzyme ?enzyme .
?reaction kegg:equation ?equation . }
```

**BioFed: Federated Query Processing over Life Sciences Linked Open Data**

SPARQL Query: **BioFed** : BioFed graph

Query Builder Type:  Standard

Query Builder

Make selection -- Reset Query

```
PREFIX drugcategory: <http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugcategory/>
PREFIX drugbank: <http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugbank/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX kegg: <http://bio2rdf.org/ns/kegg#>
SELECT ?drugDesc ?cpd ?equation WHERE {
?drug drugbank:drugCategory drugcategory:cathartics .
?drug drugbank:keggCompoundId ?cpd .
?drug drugbank:description ?drugDesc .
?enzyme kegg:xSubstrate ?cpd .
?enzyme rdf:type kegg:Enzyme .
?reaction kegg:xEnzyme ?enzyme .
?reaction kegg:equation ?equation . }
```

Output:

Query Status [show](#)

Query Result

192 results displayed

drugDesc	cpd	equation
A polyhydric alcohol with about half the sweetness of sucrose. Sorbitol occurs naturally and is also produced synthetically from glucose. It was formerly used as a diuretic and may still be used as a laxative and in irrigating solutions for some surgical procedures. It is also used in many manufacturing processes, as a pharmaceutical aid, and in several research applications. [PubChem]	http://bio2rdf.org/cpd:C00794	C00794 + C00006 <=> C00247 + C00005 + C00080
A polyhydric alcohol with about half the sweetness of sucrose. Sorbitol occurs naturally and is also produced synthetically from glucose. It was formerly used as a diuretic and may still be used as a laxative and in irrigating solutions for some surgical procedures. It is also used in many manufacturing processes, as a pharmaceutical aid, and in several research applications. [PubChem]	http://bio2rdf.org/cpd:C00794	C00794 + C00006 <=> C00247 + C00005 + C00080
A polyhydric alcohol with about half the sweetness of sucrose. Sorbitol occurs naturally and is also produced synthetically from glucose. It was formerly used as a diuretic and may still be used as a laxative and in irrigating solutions for some surgical procedures. It is also used in many manufacturing processes, as a pharmaceutical aid, and in several research applications. [PubChem]	http://bio2rdf.org/cpd:C00794	C00794 + C00006 <=> C00247 + C00005 + C00080
A polyhydric alcohol with about half the sweetness of sucrose. Sorbitol occurs naturally and is also produced synthetically from glucose. It was formerly used as a diuretic and may still be used as a laxative and in irrigating solutions for some surgical procedures. It is also used in many manufacturing processes, as a pharmaceutical aid, and in several research applications. [PubChem]	http://bio2rdf.org/cpd:C00794	C00794 + C00006 <=> C00247 + C00005

Figure 6: Simple Federated SPARQL query execution through BioFed Interface

Let us consider Complex Query 2 and copy it to the interface and execute the query

**CQ2: Find all the drugs with their mass and chebi lupacName optionally the Inchi values retrieving from two sources are equal.**

```

PREFIX drugbank: <http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugbank/>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX chebi: <http://bio2rdf.org/ns/chebi#>
PREFIX purl: <http://purl.org/dc/elements/1.1/>
PREFIX bio2RDF: <http://bio2rdf.org/ns/bio2rdf#>
SELECT * WHERE {
?drug rdf:type drugbank:drugs .
?drug drugbank:keggCompoundId ?keggDrug .
?keggDrug bio2RDF:mass ?keggmass .
?drug drugbank:genericName ?drugBankName .
?chebiDrug purl:title ?drugBankName .
?chebiDrug chebi:iupacName ?chebilupacName .
OPTIONAL {
?drug drugbank:inchiIdentifier ?drugbankInchi .
?chebiDrug bio2RDF:inchi ?chebilInchi.
FILTER (?drugbankInchi = ?chebilInchi) }

```

drug	keggDrug	keggmass	drugBankName	chebiDrug	chebiIupacName	drugbankInchi	chebiInchi
http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugs/D800157	http://pubchem.ncbi.nlm.nih.gov/compound/6481246	648.1246	NADH	http://bio2rdf.org/chebi/16908	adenosine 5'-[3-1-β-carbamoyl-1,4-dihydropyridin-1-yl]-L-allyldro-riboside-5'	InChI=1/C21H29N7O4F2/c22-17-12-19(25-7-24-17)28(8-26-12)31-16(32)14(30)11(41-21)16-39-44(36,37)42-43(34,35)38(9-10-13)29(15)12(20)40-10(17)3-1-2-9(6-4-27)18(23)33(13-4-7-8,10-11,13-16,20-21,29-32)H,2,5-6H2,(H2,23,33)(H,34,35)(H,36,37)(H2,22,24,29)F16-11,13-14,15-16-20-21-m/14167934,36H,22-23H2	InChI=1/C21H29N7O4F2/c22-17-12-19(25-7-24-17)28(8-26-12)31-16(32)14(30)11(41-21)16-39-44(36,37)42-43(34,35)38(9-10-13)29(15)12(20)40-10(17)3-1-2-9(6-4-27)18(23)33(13-4-7-8,10-11,13-16,20-21,29-32)H,2,5-6H2,(H2,23,33)(H,34,35)(H,36,37)(H2,22,24,29)F16-11,13-14,15-16-20-21-m/14167934,36H,22-23H2
http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugs/D800157	http://bio2rdf.org/epd/C00004	665.1248	NADH	http://bio2rdf.org/chebi/16908	adenosine 5'-[3-1-β-carbamoyl-1,4-dihydropyridin-1-yl]-L-allyldro-riboside-5'	InChI=1/C21H29N7O4F2/c22-17-12-19(25-7-24-17)28(8-26-12)31-16(32)14(30)11(41-21)16-39-44(36,37)42-43(34,35)38(9-10-13)29(15)12(20)40-10(17)3-1-2-9(6-4-27)18(23)33(13-4-7-8,10-11,13-16,20-21,29-32)H,2,5-6H2,(H2,23,33)(H,34,35)(H,36,37)(H2,22,24,29)F16-11,13-14,15-16-20-21-m/14167934,36H,22-23H2	InChI=1/C21H29N7O4F2/c22-17-12-19(25-7-24-17)28(8-26-12)31-16(32)14(30)11(41-21)16-39-44(36,37)42-43(34,35)38(9-10-13)29(15)12(20)40-10(17)3-1-2-9(6-4-27)18(23)33(13-4-7-8,10-11,13-16,20-21,29-32)H,2,5-6H2,(H2,23,33)(H,34,35)(H,36,37)(H2,22,24,29)F16-11,13-14,15-16-20-21-m/14167934,36H,22-23H2
http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugs/D800157	http://bio2rdf.org/epd/C00004	665.1248	NADH	http://bio2rdf.org/chebi/16908	adenosine 5'-[3-1-β-carbamoyl-1,4-dihydropyridin-1-yl]-L-allyldro-riboside-5'	InChI=1/C21H29N7O4F2/c22-17-12-19(25-7-24-17)28(8-26-12)31-16(32)14(30)11(41-21)16-39-44(36,37)42-43(34,35)38(9-10-13)29(15)12(20)40-10(17)3-1-2-9(6-4-27)18(23)33(13-4-7-8,10-11,13-16,20-21,29-32)H,2,5-6H2,(H2,23,33)(H,34,35)(H,36,37)(H2,22,24,29)F16-11,13-14,15-16-20-21-m/14167934,36H,22-23H2	InChI=1/C21H29N7O4F2/c22-17-12-19(25-7-24-17)28(8-26-12)31-16(32)14(30)11(41-21)16-39-44(36,37)42-43(34,35)38(9-10-13)29(15)12(20)40-10(17)3-1-2-9(6-4-27)18(23)33(13-4-7-8,10-11,13-16,20-21,29-32)H,2,5-6H2,(H2,23,33)(H,34,35)(H,36,37)(H2,22,24,29)F16-11,13-14,15-16-20-21-m/14167934,36H,22-23H2
http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugs/D800157	http://bio2rdf.org/epd/C00004	665.1248	NADH	http://bio2rdf.org/chebi/16908	adenosine 5'-[3-1-β-carbamoyl-1,4-dihydropyridin-1-yl]-L-allyldro-riboside-5'	InChI=1/C21H29N7O4F2/c22-17-12-19(25-7-24-17)28(8-26-12)31-16(32)14(30)11(41-21)16-39-44(36,37)42-43(34,35)38(9-10-13)29(15)12(20)40-10(17)3-1-2-9(6-4-27)18(23)33(13-4-7-8,10-11,13-16,20-21,29-32)H,2,5-6H2,(H2,23,33)(H,34,35)(H,36,37)(H2,22,24,29)F16-11,13-14,15-16-20-21-m/14167934,36H,22-23H2	InChI=1/C21H29N7O4F2/c22-17-12-19(25-7-24-17)28(8-26-12)31-16(32)14(30)11(41-21)16-39-44(36,37)42-43(34,35)38(9-10-13)29(15)12(20)40-10(17)3-1-2-9(6-4-27)18(23)33(13-4-7-8,10-11,13-16,20-21,29-32)H,2,5-6H2,(H2,23,33)(H,34,35)(H,36,37)(H2,22,24,29)F16-11,13-14,15-16-20-21-m/14167934,36H,22-23H2
http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugs/D800157	http://bio2rdf.org/epd/C00004	665.1248	NADH	http://bio2rdf.org/chebi/16908	adenosine 5'-[3-1-β-carbamoyl-1,4-dihydropyridin-1-yl]-L-allyldro-riboside-5'	InChI=1/C21H29N7O4F2/c22-17-12-19(25-7-24-17)28(8-26-12)31-16(32)14(30)11(41-21)16-39-44(36,37)42-43(34,35)38(9-10-13)29(15)12(20)40-10(17)3-1-2-9(6-4-27)18(23)33(13-4-7-8,10-11,13-16,20-21,29-32)H,2,5-6H2,(H2,23,33)(H,34,35)(H,36,37)(H2,22,24,29)F16-11,13-14,15-16-20-21-m/14167934,36H,22-23H2	InChI=1/C21H29N7O4F2/c22-17-12-19(25-7-24-17)28(8-26-12)31-16(32)14(30)11(41-21)16-39-44(36,37)42-43(34,35)38(9-10-13)29(15)12(20)40-10(17)3-1-2-9(6-4-27)18(23)33(13-4-7-8,10-11,13-16,20-21,29-32)H,2,5-6H2,(H2,23,33)(H,34,35)(H,36,37)(H2,22,24,29)F16-11,13-14,15-16-20-21-m/14167934,36H,22-23H2
http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugs/D800157	http://bio2rdf.org/epd/C00004	665.1248	NADH	http://bio2rdf.org/chebi/16908	adenosine 5'-[3-1-β-carbamoyl-1,4-dihydropyridin-1-yl]-L-allyldro-riboside-5'	InChI=1/C21H29N7O4F2/c22-17-12-19(25-7-24-17)28(8-26-12)31-16(32)14(30)11(41-21)16-39-44(36,37)42-43(34,35)38(9-10-13)29(15)12(20)40-10(17)3-1-2-9(6-4-27)18(23)33(13-4-7-8,10-11,13-16,20-21,29-32)H,2,5-6H2,(H2,23,33)(H,34,35)(H,36,37)(H2,22,24,29)F16-11,13-14,15-16-20-21-m/14167934,36H,22-23H2	InChI=1/C21H29N7O4F2/c22-17-12-19(25-7-24-17)28(8-26-12)31-16(32)14(30)11(41-21)16-39-44(36,37)42-43(34,35)38(9-10-13)29(15)12(20)40-10(17)3-1-2-9(6-4-27)18(23)33(13-4-7-8,10-11,13-16,20-21,29-32)H,2,5-6H2,(H2,23,33)(H,34,35)(H,36,37)(H2,22,24,29)F16-11,13-14,15-16-20-21-m/14167934,36H,22-23H2
http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugs/D800157	http://bio2rdf.org/epd/C00004	665.1248	NADH	http://bio2rdf.org/chebi/16908	adenosine 5'-[3-1-β-carbamoyl-1,4-dihydropyridin-1-yl]-L-allyldro-riboside-5'	InChI=1/C21H29N7O4F2/c22-17-12-19(25-7-24-17)28(8-26-12)31-16(32)14(30)11(41-21)16-39-44(36,37)42-43(34,35)38(9-10-13)29(15)12(20)40-10(17)3-1-2-9(6-4-27)18(23)33(13-4-7-8,10-11,13-16,20-21,29-32)H,2,5-6H2,(H2,23,33)(H,34,35)(H,36,37)(H2,22,24,29)F16-11,13-14,15-16-20-21-m/14167934,36H,22-23H2	InChI=1/C21H29N7O4F2/c22-17-12-19(25-7-24-17)28(8-26-12)31-16(32)14(30)11(41-21)16-39-44(36,37)42-43(34,35)38(9-10-13)29(15)12(20)40-10(17)3-1-2-9(6-4-27)18(23)33(13-4-7-8,10-11,13-16,20-21,29-32)H,2,5-6H2,(H2,23,33)(H,34,35)(H,36,37)(H2,22,24,29)F16-11,13-14,15-16-20-21-m/14167934,36H,22-23H2
http://www4.wiwiss.fu-berlin.de/drugbank/resource/drugs/D801694	http://bio2rdf.org/epd/C02107	150.0164	D-tartaric acid	http://bio2rdf.org/chebi/15672	(2S,3S)-3-dihydrobutanedioic acid	InChI=1/C4H4O4/c1-3-4-2/h1,3-4/t2,3	InChI=1/C4H4O4/c1-3-4-2/h1,3-4/t2,3

Figure 7: Complex Federated SPARQL query execution through BioFed Interface

## Important Note

BioFed is designed to query real world life science publicly available SPARQL endpoints. The example previously mentioned in the paper was just an example and results are not guaranteed considering the remote endpoints are not under the control of one who query those but the publishers. This means if any of the SPARQL endpoint contributing to the result of any of the triple patterns mentioned in the query is not available the overall result cannot be constituted hence we will not get any answer.