Towards a knowledge graph for pre-/probiotics and microbiota-gut-brain axis diseases

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SPARQL protocols for query cases

SI Listing 1: The SPARQL protocol for query case 1: retrieve the health effects of *B. bifidum* treatment

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SI Listing 1. The SPARQL protocol for query case 1: retrieve the health effects of *B. bifidum* treatment

```sparql
1    prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
2    prefix owl: <http://www.w3.org/2002/07/owl#>
3    prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
4    prefix ppconcept: <http://wasp.cs.vu.nl/ppconcept#>
5    prefix ppstatement: <http://wasp.cs.vu.nl/ppstatement#>
6
7    select distinct ?pmid ?probiotics ?species ?population ?regulate ?effect
8
9    where {
10       {?statement  ppstatement:hasProbiotics  ppstatement:Bifidobacterium_bifidum ;
11                    ppstatement:hasSpecies      ?species ;
12                    ppstatement:hasPopulation   ?population ;
13                    ppstatement:hasRegulation   ?regulate ;
14                    ppstatement:hasEffectOn     ?effect ;
15                    ppstatement:hasReference    ?reference .
16        ?reference  ppstatement:hasPMID         ?pmid .}
17   union
18       {?statement  ppstatement:hasProbiotics  ?probiotics ;
19                    ppstatement:hasSpecies      ?species ;
20                    ppstatement:hasPopulation   ?population ;
21                    ppstatement:hasRegulation   ?regulate ;
22                    ppstatement:hasEffectOn     ?effect ;
23                    ppstatement:hasReference    ?reference .
24        ?reference  ppstatement:hasPMID         ?pmid .
25        ?probiotics rdfs:subClassOf             ppstatement:Bifidobacterium_bifidum .}
26   union
27       {?statement  ppstatement:hasProbiotics  ?probiotics ;
28                    ppstatement:hasSpecies      ?species ;
29                    ppstatement:hasPopulation   ?population ;
30                    ppstatement:hasRegulation   ?regulate ;
31                    ppstatement:hasEffectOn     ?effect ;
32                    ppstatement:hasReference    ?reference .
33        ?reference  ppstatement:hasPMID         ?pmid .
34        ?probiotics a                           owl:Class ;
35                    owl:intersectionOf          ?mixture .
36        ?mixture    rdf:rest*/rdf:first         ?composition .
37        ?mixture    rdf:rest*/rdf:first         ppstatement:Bifidobacterium_bifidum .}
38   union
39       {?statement  ppstatement:hasProbiotics  ?probiotics ;
40                    ppstatement:hasSpecies      ?species ;
41                    ppstatement:hasPopulation   ?population ;
42                    ppstatement:hasRegulation   ?regulate ;
43                    ppstatement:hasEffectOn     ?effect ;
44                    ppstatement:hasReference    ?reference .
45        ?reference  ppstatement:hasPMID         ?pmid .
46        ?probiotics a                           owl:Class ;
47                    owl:intersectionOf          ?mixture .
48        ?mixture    rdf:rest*/rdf:first         ?composition .
49        ?composition rdfs:subClassOf            ppstatement:Bifidobacterium_bifidum .}
50       }
```

SI Listing 2. The SPARQL protocol for query case 2: retrieve all probiotics that impact sleep conditions

```
1    prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
2    prefix owl: <http://www.w3.org/2002/07/owl#>
3    prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
4    prefix snomed: <http://wasp.cs.vu.nl/sct/sct#>
5    prefix ppconcept: <http://wasp.cs.vu.nl/ppconcept#>
6    prefix ppstatement: <http://wasp.cs.vu.nl/ppstatement#>
7
8    select distinct ?pmid ?text1
9
10   where {
11       ?url1      rdfs:subClassOf              <http://www.ihtsdo.org/SCT_106168000> .
12       ?url1      snomed:hasEnglishLabel       ?urlLabel1 .
13       ?sense1    ppconcept:SenseURL           ?url1 .
14       ?senses1   ppconcept:hasSense           ?sense1 .
15       ?term1     ppconcept:hasSenses          ?senses1 .
16       ?annot1    ppconcept:hasLabel           ?termLabel1 .
17       ?annot1    ppconcept:hasTerm            ?term1 .
18       ?annos1    ppconcept:hasAnnotation      ?annot1 .
19       ?annos1    ppconcept:hasSource          ?source1 .
20       ?annos1    ppconcept:hasText            ?text1 .
21       ?pmid      ppconcept:hasAnnotations     ?annos1 .
22       ?pmid      ppconcept:hasAnnotations     ?annos2 .
23       ?annos2    ppconcept:hasText            ?text2 .
24       ?annos2    ppconcept:hasSource          ?source2 .
25       ?annos2    ppconcept:hasAnnotation      ?annot2 .
26       ?annot2    ppconcept:hasTerm            ?term2 .
27       ?annot2    ppconcept:hasLabel           ?termLabel2 .
28       ?term2     ppconcept:hasSenses          ?senses2 .
29       ?senses2   ppconcept:hasSense           ?sense2 .
30       ?sense2    ppconcept:SenseURL           ?url2 .
31       ?url2      snomed:hasEnglishLabel       ?urlLabel2 .
32       ?url2      rdfs:subClassOf              <http://www.ihtsdo.org/SCT_264395009> .}
33   order by asc (?pmid)
```

SI Listing 3. The SPARQL protocol for query case 3: retrieve probiotics that affect BDNF gene expression

```
1   prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
2   prefix owl: <http://www.w3.org/2002/07/owl#>
3   prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
4   prefix snomed: <http://wasp.cs.vu.nl/sct/sct#>
5   prefix ppconcept: <http://wasp.cs.vu.nl/ppconcept#>
6   prefix ppstatement: <http://wasp.cs.vu.nl/ppstatement#>
7
8   select distinct ?pmid ?probiotics ?composition ?url ?text1 ?urlLabel1
9
10  where {
11      {?statement    ppstatement:hasEffectOn    ?effect .
12      ?statement     ppstatement:hasProbiotics  ?probiotics .
13      ?statement     ppstatement:hasSpecies     ?species .
14      ?statement     ppstatement:hasReference   ?reference .
15      ?reference     ppstatement:hasPMID        ?pmid .
16      ?probiotics    owl:sameAs                 ?url .
17      filter regex   (?effect,"bdnf","i")}
18  Union
19      {?statement    ppstatement:hasEffectOn    ?effect .
20      ?statement     ppstatement:hasProbiotics  ?probiotics .
21      ?statement     ppstatement:hasSpecies     ?species .
22      ?statement     ppstatement:hasReference   ?reference .
23      ?reference     ppstatement:hasPMID        ?pmid .
24      ?probiotics    a                          owl:Class ;
25                     owl:intersectionOf         ?mixture .
26      ?mixture       rdf:rest*/rdf:first        ?composition .
27      ?composition   owl:sameAs                 ?url .
28      filter regex   (?effect,"bdnf","i")}
29  union
30      {?url1         rdfs:subClassOf            <http://www.ihtsdo.org/SCT_264395009> .
31      ?url1          snomed:hasEnglishLabel     ?urlLabel1 .
32      ?sense1        ppconcept:SenseURL         ?url1 .
33      ?senses1       ppconcept:hasSense         ?sense1 .
34      ?term1         ppconcept:hasSenses        ?senses1 .
35      ?annot1        ppconcept:hasLabel         ?termLabel1 .
36      ?annot1        ppconcept:hasTerm          ?term1 .
37      ?annos1        ppconcept:hasAnnotation    ?annot1 .
38      ?annos1        ppconcept:hasSource        ?source1 .
39      ?annos1        ppconcept:hasText          ?text1 .
40      ?pmid          ppconcept:hasAnnotations   ?annos1 .
41      filter regex   (?text1,"bdnf","i")}
42      }
```

SI Listing 4. TheSPARQL protocol for query case 4: retrieve all probiotics that impact depressive disorder

```
1    prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
2    prefix owl: <http://www.w3.org/2002/07/owl#>
3    prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
4    prefix snomed: <http://wasp.cs.vu.nl/sct/sct#>
5    prefix ppconcept: <http://wasp.cs.vu.nl/ppconcept#>
6    prefix ppstatement: <http://wasp.cs.vu.nl/ppstatement#>
7
8    select distinct ?pmid ?probiotics ?regulate ?effect ?composition ?text1 ?text2
9
10   where {
11       {?statement      ppstatement:hasPopulation   ppstatement:Depressive_disorder ;
12                        ppstatement:hasSpecies      ?species ;
13                        ppstatement:hasProbiotics   ?probiotics ;
14                        ppstatement:hasRegulation   ?regulate ;
15                        ppstatement:hasEffectOn     ?effect ;
16                        ppstatement:hasReference    ?reference .
17       ?reference       ppstatement:hasPMID         ?pmid .}
18   union
19       {?statement      ppstatement:hasPopulation   ppstatement:Depressive_disorder ;
20                        ppstatement:hasSpecies      ?species ;
21                        ppstatement:hasProbiotics   ?probiotics ;
22                        ppstatement:hasRegulation   ?regulate ;
23                        ppstatement:hasEffectOn     ?effect ;
24                        ppstatement:hasReference    ?reference .
25       ?reference       ppstatement:hasPMID         ?pmid .
26       ?probiotics      a                           owl:Class ;
27                        owl:intersectionOf          ?mixture .
28       ?mixture         rdf:rest*/rdf:first         ?composition .}
29   union
30       {?url1           rdfs:subClassOf             <http://www.ihtsdo.org/SCT_264395009> .
31       ?url1            snomed:hasEnglishLabel      ?urlLabel1 .
32       ?sense1          ppconcept:SenseURL          ?url1 .
33       ?senses1         ppconcept:hasSense          ?sense1 .
34       ?term1           ppconcept:hasSenses         ?senses1 .
35       ?annot1          ppconcept:hasLabel          ?termLabel1 .
36       ?annot1          ppconcept:hasTerm           ?term1 .
37       ?annos1          ppconcept:hasAnnotation     ?annot1 .
38       ?annos1          ppconcept:hasSource         ?source1 .
39       ?annos1          ppconcept:hasText           ?text1 .
40       ?pmid            ppconcept:hasAnnotations    ?annos1 .
41       filter regex     (?text1,"depress","i")}
42   union
43       {?sense2         ppconcept:SenseURL          ?url2 .
44       ?senses2         ppconcept:hasSense          ?sense2 .
45       ?term2           ppconcept:hasSenses         ?senses2 .
46       ?annot2          ppconcept:hasLabel          ?termLabel2 .
47       ?annot2          ppconcept:hasTerm           ?term2 .
48       ?annos2          ppconcept:hasAnnotation     ?annot2 .
49       ?annos2          ppconcept:hasSource         ?source2 .
50       ?annos2          ppconcept:hasText           ?text2 .
51       ?pmid            ppconcept:hasAnnotations    ?annos2 .
52       filter regex(?text2,"depress","i")
53       filter regex(?text2,"probiotic","i")}
54       }
```