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 \textit{B. bifidum} treatment

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

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

SI Listing 4: The SPARQL protocol for query case 4: retrieve all probiotics that impact depressive disorder
SI Listing 1. The SPARQL protocol for query case 1: retrieve the health effects of \textit{B. bifidum} treatment

```sql
prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
prefix owl: <http://www.w3.org/2002/07/owl#>
prefix ppconcept: <http://wasp.cs.vu.nl/ppconcept#>
prefix ppstatement: <http://wasp.cs.vu.nl/ppstatement#>

select distinct ?pmid ?probiotics ?species ?population ?regulate ?effect where {
    {?statement ppstatement:hasProbiotics ppstatement:Bifidobacterium_bifidum ;
    ppstatement:hasSpecies ?species ;
    ppstatement:hasPopulation ?population ;
    ppstatement:hasRegulation ?regulate ;
    ppstatement:hasEffectOn ?effect ;
    ppstatement:hasReference ?reference .
    ?reference ppstatement:hasPMID ?pmid .}
    union
    {?statement ppstatement:hasProbiotics ?probiotics ;
    ppstatement:hasSpecies ?species ;
    ppstatement:hasPopulation ?population ;
    ppstatement:hasRegulation ?regulate ;
    ppstatement:hasEffectOn ?effect ;
    ppstatement:hasReference ?reference .
    ?probiotics rdfs:subClassOf ppstatement:Bifidobacterium_bifidum .}
    union
    {?statement ppstatement:hasProbiotics ?probiotics ;
    ppstatement:hasSpecies ?species ;
    ppstatement:hasPopulation ?population ;
    ppstatement:hasRegulation ?regulate ;
    ppstatement:hasEffectOn ?effect ;
    ppstatement:hasReference ?reference .
    ?probiotics a owl:Class ;
    ?mixture rdf:rest*/rdf:first ?composition .
    ?mixture rdf:rest*/rdf:first ppstatement:Bifidobacterium_bifidum .}
    union
    {?statement ppstatement:hasProbiotics ?probiotics ;
    ppstatement:hasSpecies ?species ;
    ppstatement:hasPopulation ?population ;
    ppstatement:hasRegulation ?regulate ;
    ppstatement:hasEffectOn ?effect ;
    ppstatement:hasReference ?reference .
    ?probiotics a owl:Class ;
    ?mixture rdf:rest*/rdf:first ?composition .
    ?composition rdfs:subClassOf ppstatement:Bifidobacterium_bifidum .}
}
```
SI Listing 2. The SPARQL protocol for query case 2: retrieve all probiotics that impact sleep conditions

```sparql
prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
prefix owl: <http://www.w3.org/2002/07/owl#>
prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
prefix snomed: <http://wasp.cs.vu.nl/sct/sct#>
prefix ppconcept: <http://wasp.cs.vu.nl/ppconcept#>
prefix ppstatement: <http://wasp.cs.vu.nl/ppstatement#>

select distinct ?pmid ?text1

where {
  ?url1 rdfs:subClassOf <http://www.ihtsdo.org/SCT_106168000> .
  ?url1 snomed:hasEnglishLabel ?urlLabel1 .
  ?sense1 ppconcept:SenseURL ?url1 .
  ?senses1 ppconcept:hasSense ?sense1 .
  ?term1 ppconcept:hasSenses ?senses1 .
  ?annot1 ppconcept:hasLabel ?termLabel1 .
  ?annot1 ppconcept:hasTerm ?term1 .
  ?annos1 ppconcept:hasAnnotation ?annot1 .
  ?annos1 ppconcept:hasSource ?source1 .
  ?annos1 ppconcept:hasText ?text1 .
  ?pmid ppconcept:hasAnnotations ?annos1 .
  ?pmid ppconcept:hasAnnotations ?annos2 .
  ?annos2 ppconcept:hasText ?text2 .
  ?annos2 ppconcept:hasSource ?source2 .
  ?annos2 ppconcept:hasAnnotation ?annot2 .
  ?annot2 ppconcept:hasTerm ?term2 .
  ?annot2 ppconcept:hasLabel ?termLabel2 .
  ?term2 ppconcept:hasSenses ?senses2 .
  ?sense2 ppconcept:hasSense ?sense2 .
  ?sense2 ppconcept:SenseURL ?url2 .
  ?url2 snomed:hasEnglishLabel ?urlLabel2 .
  ?url2 rdf:subClassOf <http://www.ihtsdo.org/SCT_264395009> .
}
order by asc (?pmid)
```
prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
prefix owl: <http://www.w3.org/2002/07/owl#>
prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
prefix snomed: <http://wasp.cs.vu.nl/sct/sct#>
prefix ppconcept: <http://wasp.cs.vu.nl/ppconcept#>
prefix ppstatement: <http://wasp.cs.vu.nl/ppstatement#>

select distinct ?pmid ?probiotics ?composition ?url ?text1 ?urlLabel1

where {

  {?statement ppstatement:hasEffectOn ?effect .
   ?statement ppstatement:hasProbiotics ?probiotics .
   ?statement ppstatement:hasSpecies ?species .
   ?statement ppstatement:hasReference ?reference .
   ?reference ppstatement:hasPMID ?pmid .
   ?probiotics owl:sameAs ?url .
   filter regex (?effect,"bdnf","i")
  }

  Union
  {
    {?statement ppstatement:hasEffectOn ?effect .
     ?statement ppstatement:hasProbiotics ?probiotics .
     ?statement ppstatement:hasSpecies ?species .
     ?statement ppstatement:hasReference ?reference .
     ?reference ppstatement:hasPMID ?pmid .
     ?probiotics a owl:Class ;
     owl:intersectionOf ?mixture .
     ?mixture rdf:rest */rdf:first ?composition .
     ?composition owl:sameAs ?url .
     filter regex (?effect,"bdnf","i")
    }

    {?url1 rdfs:subClassOf <http://www.ihtsdo.org/SCT_264395009> .
     ?url1 snomed:hasEnglishLabel ?urlLabel1 .
     ?sense1 ppconcept:SenseURL ?url1 .
     ?senses1 ppconcept:hasSense ?sense1 .
     ?term1 ppconcept:hasSenses ?senses1 .
     ?annot1 ppconcept:hasLabel ?termLabel1 .
     ?annot1 ppconcept:hasTerm ?term1 .
     ?annos1 ppconcept:hasAnnotation ?annot1 .
     ?ansos1 ppconcept:hasSource ?source1 .
     ?annos1 ppconcept:hasText ?text1 .
     ?pmid ppconcept:hasAnnotations ?annos1 .
     filter regex (?text1,"bdnf","i")
    }

  }
}

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

```
prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
prefix owl: <http://www.w3.org/2002/07/owl#>
prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>
prefix snomed: <http://wasp.cs.vu.nl/sct/sct#>
prefix ppconcept: <http://wasp.cs.vu.nl/ppconcept#>
prefix ppstatement: <http://wasp.cs.vu.nl/ppstatement#>

select distinct ?pmid ?probiotics ?regulate ?effect ?composition ?text1 ?text2

where {
  {?statement ppstatement:hasPopulation ppstatement:Depressive_disorder ;
    ppstatement:hasSpecies ?species ;
    ppstatement:hasProbiotics ?probiotics ;
    ppstatement:hasRegulation ?regulate ;
    ppstatement:hasEffectOn ?effect ;
    ppstatement:hasReference ?reference .
  }
  {?reference ppstatement:hasPMID ?pmid .}
  union
  {?statement ppstatement:hasPopulation ppstatement:Depressive_disorder ;
    ppstatement:hasSpecies ?species ;
    ppstatement:hasProbiotics ?probiotics ;
    ppstatement:hasRegulation ?regulate ;
    ppstatement:hasEffectOn ?effect ;
    ppstatement:hasReference ?reference .
  }
  union
  {?statement ppstatement:hasPopulation ppstatement:Depressive_disorder ;
    ppstatement:hasSpecies ?species ;
    ppstatement:hasProbiotics ?probiotics ;
    ppstatement:hasRegulation ?regulate ;
    ppstatement:hasEffectOn ?effect ;
    ppstatement:hasReference ?reference .
  }
  where {
    {?probiotics a owl:Class ;
    owl:intersectionOf ?mixture .
    ?mixture rdf:rest*/rdf:first ?composition .}
    union
    {?url1 rdfs:subClassOf <http://www.ihtsdo.org/SCT_264395009> .
    ?url1 snomed:hasEnglishLabel ?urlLabel1 .
    ?senses1 ppconcept:SenseURL ?url1 .
    ?term1 ppconcept:hasSense ?senses1 .
    ?annot1 ppconcept:hasLabel ?termLabel1 .
    ?annot1 ppconcept:hasTerm ?term1 .
    ?annos1 ppconcept:hasAnnotation ?annot1 .
    ?annos1 ppconcept:hasSource ?source1 .
    ?annos1 ppconcept:hasText ?text1 .
    ?pmid ppconcept:hasAnnotations ?annos1 .
    filter regex (?text1,"depress","i")
    union
    {?sense2 ppconcept:SenseURL ?url2 .
    ?senses2 ppconcept:hasSense ?sense2 .
    ?term2 ppconcept:hasSenses ?senses2 .
    ?annot2 ppconcept:hasLabel ?termLabel2 .
    ?annot2 ppconcept:hasTerm ?term2 .
    ?annos2 ppconcept:hasAnnotation ?annot2 .
    ?annos2 ppconcept:hasSource ?source2 .
    ?annos2 ppconcept:hasText ?text2 .
    ?pmid ppconcept:hasAnnotations ?annos2 .
    filter regex(?text2,"depress","i")
    filter regex(?text2,"probiotic","i")
  }
}
```