

# 白芍网络药理学

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# Contents

<b>1</b>	<b>摘要</b>	<b>1</b>
1.1	需求和结果 . . . . .	1
<b>2</b>	<b>前言</b>	<b>1</b>
<b>3</b>	<b>材料和方法</b>	<b>1</b>
3.1	材料 . . . . .	1
3.2	方法 . . . . .	1
<b>4</b>	<b>分析结果</b>	<b>2</b>
<b>5</b>	<b>结论</b>	<b>2</b>
<b>6</b>	<b>附：分析流程</b>	<b>2</b>
6.1	TCMSP 白芍成分获取 . . . . .	2
6.2	白芍所有化合物 (TCMSP) 的化学类 . . . . .	2
6.2.1	白芍的所有成分 . . . . .	2
6.2.2	白芍的苷类 (Glycosides, G) 成分和靶基因 . . . . .	3
6.3	白芍苷类 (Glycosides, G) 的网络药理学分析 . . . . .	4
6.3.1	白芍-苷类 (Glycosides, G) -靶点 . . . . .	4
6.3.2	过敏性鼻炎 (allergic rhinitis, AR) 相关基因 . . . . .	5
6.3.3	苷类 (Glycosides, G) 和过敏性鼻炎 (allergic rhinitis, AR) 靶基因的交集 . . . . .	6
6.3.4	芍药苷 (Paeoniflorin, P) 和过敏性鼻炎 (allergic rhinitis, AR) 靶基因的交集 . . . . .	6
6.4	富集分析 . . . . .	7
6.4.1	白芍苷类 (Glycosides, G) 与 AR 交集基因的富集分析 . . . . .	7
6.5	分子对接 . . . . .	8
6.5.1	芍药苷 (Paeoniflorin, P) . . . . .	8
	<b>Reference</b>	<b>10</b>

# List of Figures

1	Classification hierarchy . . . . .	3
2	Baishao Network pharmacology visualization . . . . .	4
3	Paeoniflorin Network pharmacology visualization . . . . .	5
4	Baishao glucosides targets intersect with AR related targets . . . . .	6
5	Paeoniflorin targets intersect with AR related targets . . . . .	7
6	Gly Interect genes KEGG enrichment . . . . .	7
7	Gly Interect genes GO enrichment . . . . .	8
8	Overall combining Affinity . . . . .	8
9	Paeoniflorin combine USP5 . . . . .	9

10	Paeoniflorin combine SOX18 . . . . .	10
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## List of Tables

1	Baishao Compounds and targets . . . . .	2
2	Baishao glycosides related compounds . . . . .	3
3	AR related genes . . . . .	5

# 1 摘要

## 1.1 需求和结果

- 白芍总苷 Total glucosides of paeony 中主要化学成分 10-20 个 (TCMSP 筛选下口服利用度等) 及各个化学成分对应的作用靶点 (gene 与 AR 过敏性鼻炎相关), 最终形成 drug-chemical-target gene 靶点图
  - 由于苷类 (Glycosides, G) 成分过少 (Tab. 2, Fig. 1), 没有利用 OB 筛选。由于靶点过少, 这里也没有根据 AR 相关过滤后绘制成分靶点图, 而是直接绘制, 网络药理图见 Fig. 2。其中与 AR 相关的基因见 Fig. 4。
- 将获得的靶点进行 GO, KEGG 富集分析, 目标靶点为 USP5, 关联成分为芍药苷 Paeoniflorin
  - 苷类 (Glycosides, G) 没有富集到 USP5 (TCMSP 的苷类 (Glycosides, G) 靶点信息, 不包含 USP5 和 SOX18), Fig. 6 和 Fig. 7 为富集分析结果。
- 将芍药苷 pae 单独拎出, 形成 pae-targets-pathway 网络, 此处形成的 target genes 的 GO、KEGG 富集图也需要, 备注 USP5 参与哪些部分 (功能、通路)
  - Fig. 3 为 Paeoniflorin 网络药理图 (由于靶点过少, 这里也没有根据 AR 相关过滤后绘制成分靶点图, 而是直接绘制)。Paeoniflorin 与 AR 交集基因为 Fig. 5
- 分子对接模拟芍药苷与 USP5 互作
  - 见 Fig. 8 和 Fig. 9
- 转至第 2 步目标靶点为 SOX18, 关联成分为芍药苷 Paeoniflorin
  - Paeoniflorin 不包含 SOX18
- 第 3 步中备注 SOX18 参与哪些部分 (功能、通路)
  - 不参与
- 分子对接模拟芍药苷与 SOX18 互作
  - 见 Fig. 10

# 2 前言

# 3 材料和方法

## 3.1 材料

## 3.2 方法

Mainly used method:

- Database PubChem used for querying information (e.g., InChIKey, CID) of chemical compounds; Tools of Classyfire used for get systematic classification of chemical compounds.<sup>1,2</sup>
- R package ClusterProfiler used for gene enrichment analysis.<sup>3</sup>
- The API of UniProtKB ([https://www.uniprot.org/help/api\\_queries](https://www.uniprot.org/help/api_queries)) used for mapping of names or IDs of proteins .
- Website TCMSP <https://tcmsp-e.com/tcmsp.php> used for data source.<sup>4</sup>
- AutoDock vina used for molecular docking.<sup>5</sup>

- Other R packages (eg., dplyr and ggplot2) used for statistic analysis or data visualization.

## 4 分析结果

## 5 结论

## 6 附：分析流程

### 6.1 TCMSP 白芍成分获取

Table 1 (下方表格) 为表格 Baishao Compounds and targets 概览。

(对应文件为 Figure+Table/Baishao-Compounds-and-targets.xlsx)

注：表格共有 1036 行 17 列，以下预览的表格可能省略部分数据；表格含有 85 个唯一 ‘Mol ID’。

Table 1: Baishao Compounds and targets

Mol ID	Herb_p...	Molecu.....3	Molecu.....4	MW	AlogP	Hdon	Hacc	OB (%)	Caco-2
MOL000106	Baishao	PYG	https:...	126.12	1.03	3	3	22.98	0.69
MOL000211	Baishao	Mairin	https:...	456.78	6.52	2	3	55.38	0.73
MOL000219	Baishao	BOX	https:...	121.12	0.76	0	2	31.55	0.54
MOL000219	Baishao	BOX	https:...	121.12	0.76	0	2	31.55	0.54
MOL000219	Baishao	BOX	https:...	121.12	0.76	0	2	31.55	0.54
MOL000219	Baishao	BOX	https:...	121.12	0.76	0	2	31.55	0.54
MOL000219	Baishao	BOX	https:...	121.12	0.76	0	2	31.55	0.54
MOL000219	Baishao	BOX	https:...	121.12	0.76	0	2	31.55	0.54
MOL000219	Baishao	BOX	https:...	121.12	0.76	0	2	31.55	0.54
MOL000219	Baishao	BOX	https:...	121.12	0.76	0	2	31.55	0.54
MOL000219	Baishao	BOX	https:...	121.12	0.76	0	2	31.55	0.54
MOL000219	Baishao	BOX	https:...	121.12	0.76	0	2	31.55	0.54
MOL000219	Baishao	BOX	https:...	121.12	0.76	0	2	31.55	0.54
MOL000219	Baishao	BOX	https:...	121.12	0.76	0	2	31.55	0.54
MOL000219	Baishao	BOX	https:...	121.12	0.76	0	2	31.55	0.54
MOL000219	Baishao	BOX	https:...	121.12	0.76	0	2	31.55	0.54
MOL000219	Baishao	BOX	https:...	121.12	0.76	0	2	31.55	0.54
...	...	...	...	...	...	...	...	...	...

### 6.2 白芍所有化合物 (TCMSP) 的化学类

#### 6.2.1 白芍的所有成分

Figure 1 (下方图) 为图 Classification hierarchy 概览。

(对应文件为 Figure+Table/Classification-hierarchy.pdf)

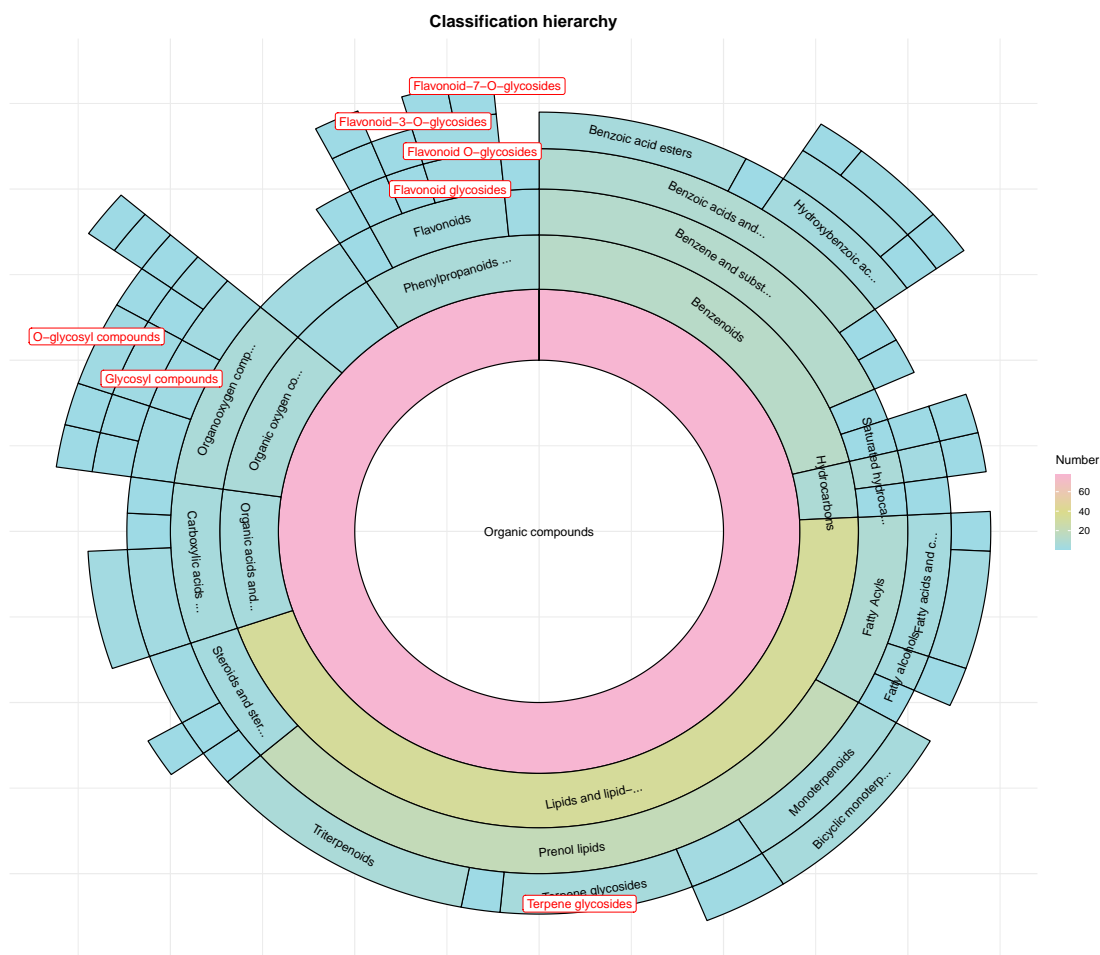


Figure 1: Classification hierarchy

### 6.2.2 白芍的苷类 (Glycosides, G) 成分和靶基因

Table 2 (下方表格) 为表格 Baishao glycosides related compounds 概览。

(对应文件为 Figure+Table/Baishao-glycosides-related-compounds.xlsx)

注：表格共有 93 行 20 列，以下预览的表格可能省略部分数据；表格含有 1 个唯一 ‘Herb\_pinyin\_name’。

Table 2: Baishao glycosides related compounds

Herb_p...	compounds	Target...	Mol ID	Molecu...	MW	AlogP	Hdon	Hacc	OB (%)
Baishao	(Z)-(1...	NA	MOL001908	https:...	446.55	-1.28	6	10	5.74
Baishao	albifl...	NA	MOL001911	https:...	480.51	-1.91	5	11	21.29
Baishao	albifl...	NA	MOL001927	https:...	480.51	-1.33	5	11	12.09
Baishao	galloy...	NA	MOL001932	https:...	632.62	-0.04	7	15	3.03
Baishao	oxypae...	NA	MOL001933	https:...	496.51	-1.55	6	12	21.88

Herb_p...	compounds	Target...	Mol ID	Molecu...	MW	AlogP	Hdon	Hacc	OB (%)
Baishao	Oxypae...	NA	MOL005089	https:...	496.51	-1.55	6	12	8.38
Baishao	sucrose	Aldose...	MOL000842	https:...	342.34	-4.31	8	11	7.17
Baishao	sucrose	Aldose...	MOL000842	https:...	342.34	-4.31	8	11	7.17
Baishao	sucrose	Aldose...	MOL000842	https:...	342.34	-4.31	8	11	7.17
Baishao	sucrose	Alpha-...	MOL000842	https:...	342.34	-4.31	8	11	7.17
Baishao	Astrag...	Calmod...	MOL000561	https:...	448.41	-0.32	7	11	14.03
Baishao	Astrag...	Calmod...	MOL000561	https:...	448.41	-0.32	7	11	14.03
Baishao	sucrose	Chitin...	MOL000842	https:...	342.34	-4.31	8	11	7.17
Baishao	Astrag...	Coagul...	MOL000561	https:...	448.41	-0.32	7	11	14.03
Baishao	Astrag...	Coagul...	MOL000561	https:...	448.41	-0.32	7	11	14.03
...	...	...	...	...	...	...	...	...	...

## 6.3 白芍苷类 (Glycosides, G) 的网络药理学分析

### 6.3.1 白芍-苷类 (Glycosides, G) -靶点

Figure 2 (下方图) 为图 Baishao Network pharmacology visualization 概览。

(对应文件为 Figure+Table/Baishao-Network-pharmacology-visualization.pdf)

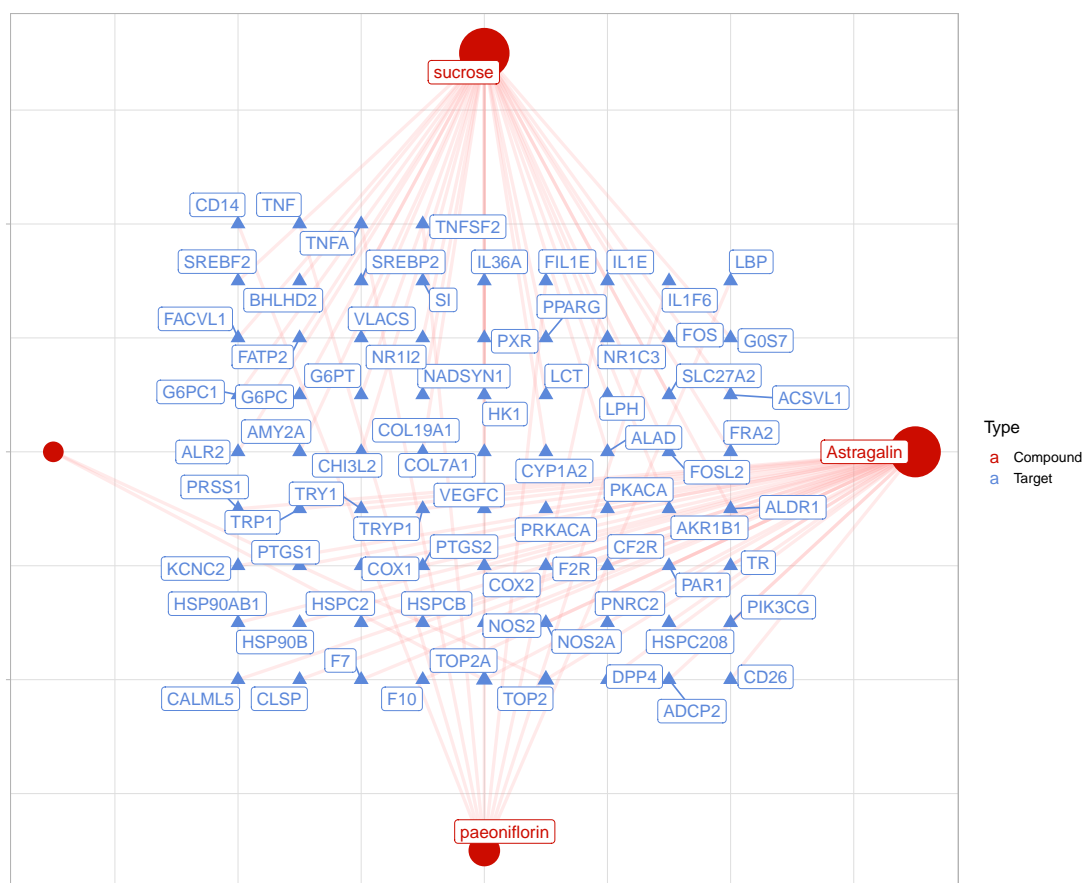


Figure 2: Baishao Network pharmacology visualization

Figure 3 (下方图) 为图 Paeoniflorin Network pharmacology visualization 概览。

(对应文件为 Figure+Table/Paeoniflorin-Network-pharmacology-visualization.pdf)

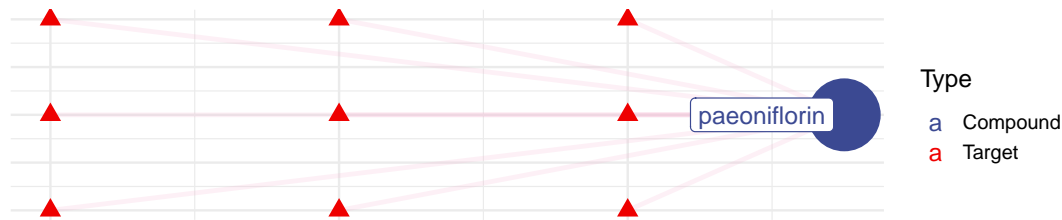


Figure 3: Paeoniflorin Network pharmacology visualization

### 6.3.2 过敏性鼻炎 (allergic rhinitis, AR) 相关基因

AR 相关基因通过 geneCards 获取，并通过 Biomart 注释。

Table 3 (下方表格) 为表格 AR related genes 概览。

(对应文件为 Figure+Table/AR-related-genes.xlsx)

注：表格共有 178 行 8 列，以下预览的表格可能省略部分数据；表格含有 178 个唯一 ‘hgnc\_symbol’。

1. hgnc\_symbol: 基因名 (Human)

Table 3: AR related genes

hgnc_s...	ensembl...	entrez...	refseq...	chromo...	start_...	end_po...	descri...
ADRB2	ENSG00...	154	NM_000024	5	148826611	148828623	adreno...
ALOX5AP	ENSG00...	241	NM_001629	13	30713478	30764426	arachi...
BDNF-AS	ENSG00...	497258		11	27506830	27698231	BDNF a...
BGLAP	ENSG00...	632	NM_199173	1	156242184	156243317	bone g...
BPIFA1	ENSG00...	51297	NM_001...	20	33235995	33243311	BPI fo...
BTK	ENSG00...	695		X	101349338	101390796	Bruton...
C5AR1	ENSG00...	728		19	47290023	47322066	comple...
CCDC40	ENSG00...	55036	NM_001...	HG2118...	59543	125319	coiled...
CCL1	ENSG00...	6346	NM_002981	17	34360328	34363233	C-C mo...
CCL18	ENSG00...	6362	NM_002988	HSCHR1...	18377	26129	C-C mo...
CCL20	ENSG00...	6364		2	227805739	227817564	C-C mo...
CCL4	ENSG00...	6351	NM_002984	HSCHR1...	57924	59718	C-C mo...
CCNO	ENSG00...	10309		5	55231152	55233608	cyclin...
CCR5	ENSG00...	1234	NM_000579	3	46370946	46376206	C-C mo...
CCR8	ENSG00...	1237	NM_005201	3	39329709	39333680	C-C mo...



hgnc_s...	ensembl...	entrez...	refseq...	chromo...	start_...	end_po...	descri...
...	...	...	...	...	...	...	...

6.3.3 苷类 (Glycosides, G) 和过敏性鼻炎 (allergic rhinitis, AR) 靶基因的交集

Figure 4 (下方图) 为图 Baishao glucosides targets intersect with AR related targets 概览。

(对应文件为 Figure+Table/Baishao-glucosides-targets-intersect-with-AR-related-targets.pdf)

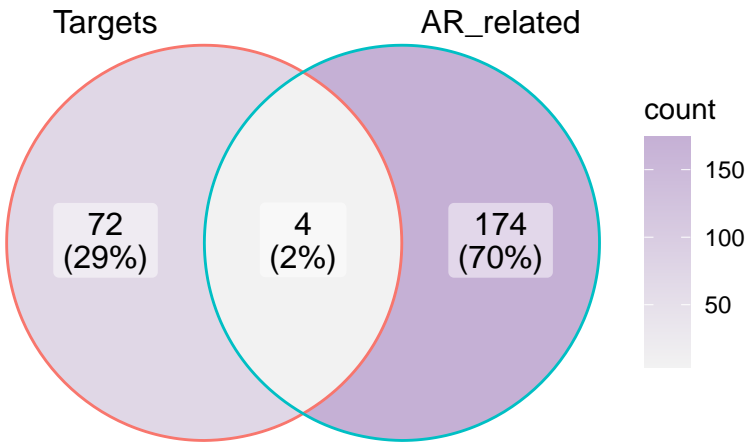


Figure 4: Baishao glucosides targets intersect with AR related targets

**Intersection :**

NOS2, PIK3CG, PTGS1, PTGS2

(上述信息框内容已保存至 Figure+Table/Baishao-glucosides-targets-intersect-with-AR-related-targets-content)

6.3.4 芍药苷 (Paeoniflorin, P) 和过敏性鼻炎 (allergic rhinitis, AR) 靶基因的交集

Figure 5 (下方图) 为图 Paeoniflorin targets intersect with AR related targets 概览。

(对应文件为 Figure+Table/Paeoniflorin-targets-intersect-with-AR-related-targets.pdf)

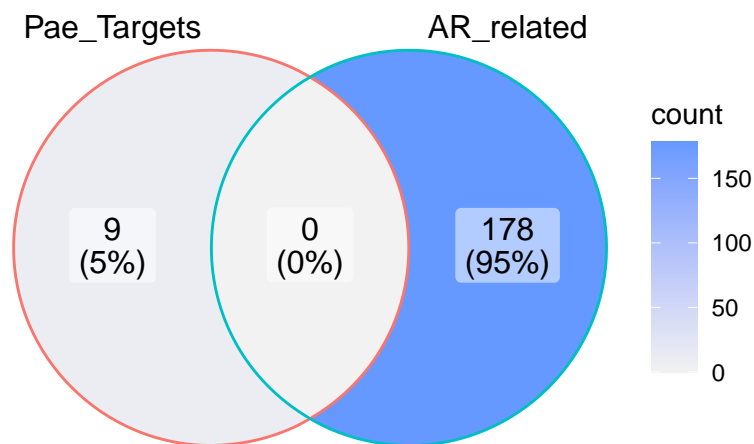


Figure 5: Paeoniflorin targets intersect with AR related targets

Intersection :

(上述信息框内容已保存至 Figure+Table/Paeoniflorin-targets-intersect-with-AR-related-targets-content)

## 6.4 富集分析

### 6.4.1 白芍苷类 (Glycosides, G) 与 AR 交集基因的富集分析

Figure 6 (下方图) 为图 Gly Intersect genes KEGG enrichment 概览。

(对应文件为 Figure+Table/Gly-Intersect-genes-KEGG-enrichment.pdf)

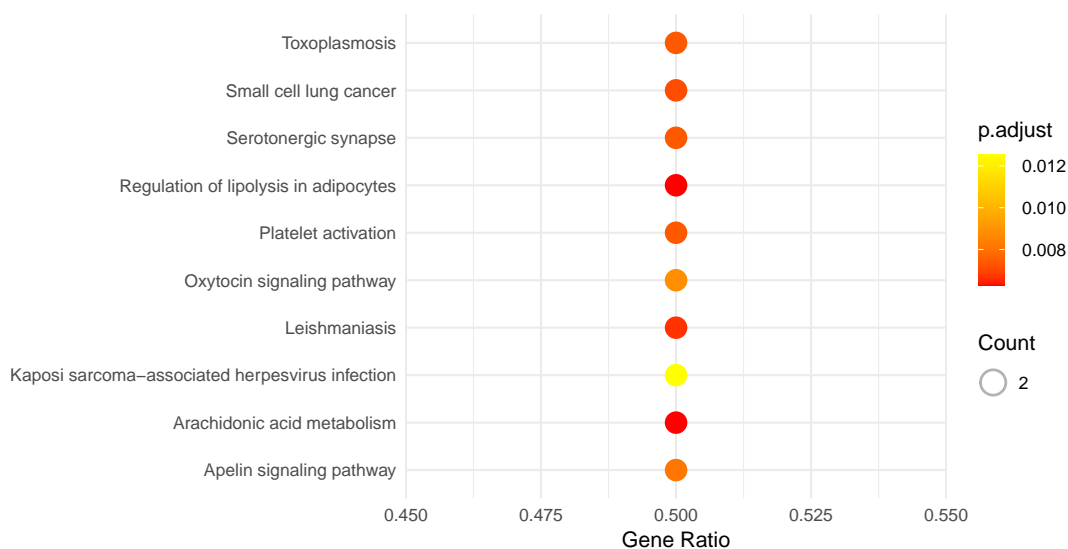


Figure 6: Gly Intersect genes KEGG enrichment

Figure 7 (下方图) 为图 Gly Intersect genes GO enrichment 概览。

(对应文件为 `Figure+Table/Gly-Interect-genes-GO-enrichment.pdf`)

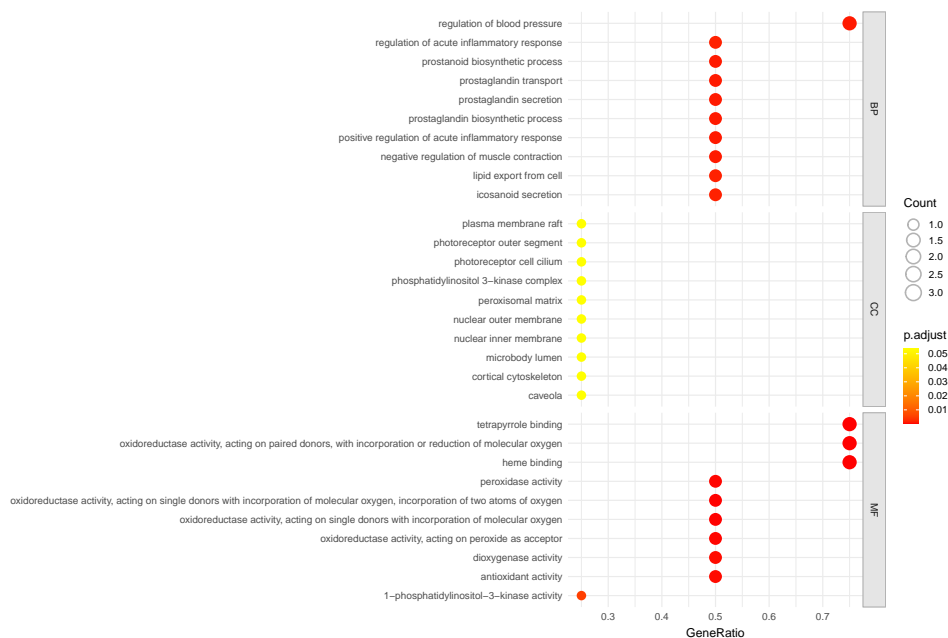


Figure 7: Gly Interect genes GO enrichment

6.5 分子对接

对接的对象为：SOX18, USP5

6.5.1 芍药苷 (Paeoniflorin, P)

Figure 8 (下方图) 为图 Overall combining Affinity 概览。

(对应文件为 `Figure+Table/Overall-combining-Affinity.pdf`)

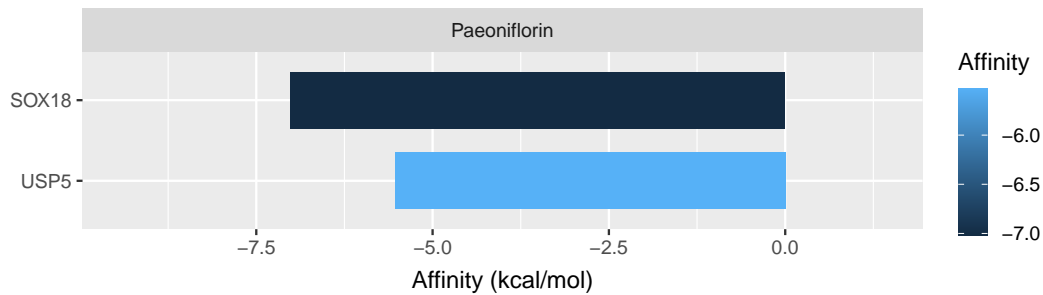


Figure 8: Overall combining Affinity

Figure 9 (下方图) 为图 Paeoniflorin combine USP5 概览。

(对应文件为 `Figure+Table/442534_into_2dag.png`)

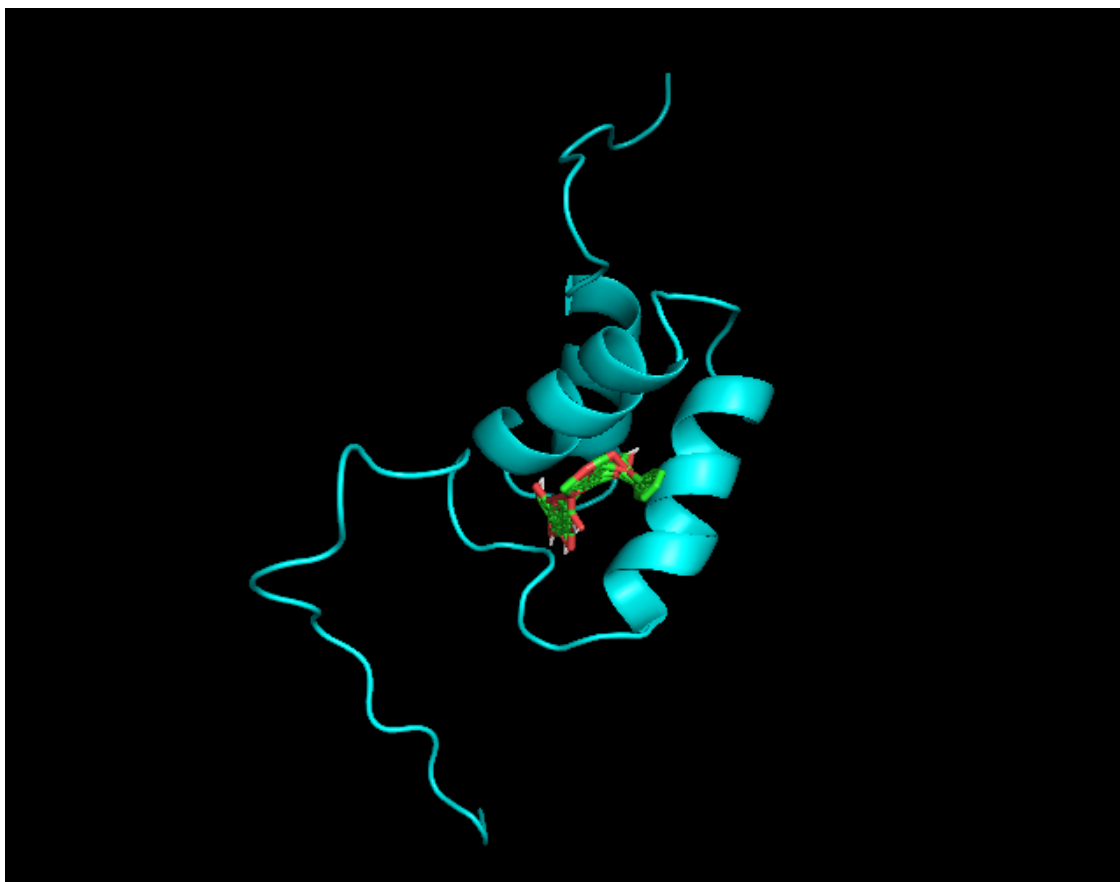


Figure 9: Paeoniflorin combine USP5

Figure 10 (下方图) 为图 Paeoniflorin combine SOX18 概览。

(对应文件为 Figure+Table/442534\_into\_sox18.png)

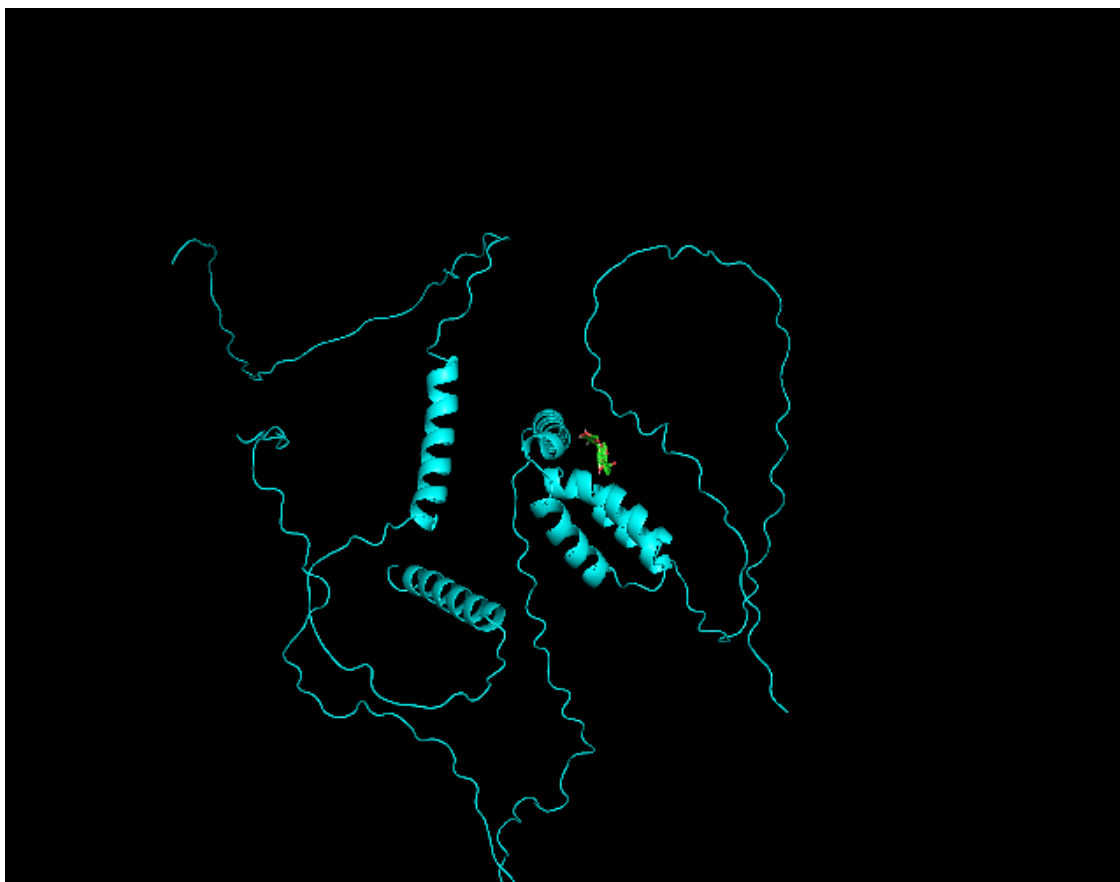


Figure 10: Paeoniflorin combine SOX18

## Reference

1. Kim, S. *et al.* PubChem substance and compound databases. *Nucleic Acids Research* (2015).
2. Djoumbou Feunang, Y. *et al.* ClassyFire: Automated chemical classification with a comprehensive, computable taxonomy. *Journal of Cheminformatics* **8**, 61 (2016).
3. Wu, T. *et al.* ClusterProfiler 4.0: A universal enrichment tool for interpreting omics data. *The Innovation* **2**, (2021).
4. Ru, J. *et al.* TCMSP: A database of systems pharmacology for drug discovery from herbal medicines. *Journal of cheminformatics* **6**, (2014).
5. Eberhardt, J., Santos-Martins, D., Tillack, A. F. & Forli, S. AutoDock vina 1.2.0: New docking methods, expanded force field, and python bindings. *Journal of Chemical Information and Modeling* **61**, 3891–3898 (2021).