

# Proteins Involved in the Plant Growth Promotion of *Pseudomonas orientalis* in the Presence of Cadmium.

<https://doi.org/10.17952/37EPS.2024.P1275>

<sup>1</sup>Ximena Carolina Pulido Villamil, <sup>1,2</sup>Jefferson Beltrán, <sup>2</sup>Maryeimy Varón-López, <sup>1</sup>Cesar Augusto Jaramillo.

<sup>1</sup>Grupo de Química Aplicada a Procesos Ecológicos (QUAPE), Universidad del Tolima, Ibagué, Colombia.

<sup>2</sup>Grupo de Genética y Biotecnología Vegetal y Microbiana (GEBIUT), Universidad del Tolima, Ibagué, Colombia.

[xpulido@ut.edu.co](mailto:xpulido@ut.edu.co)

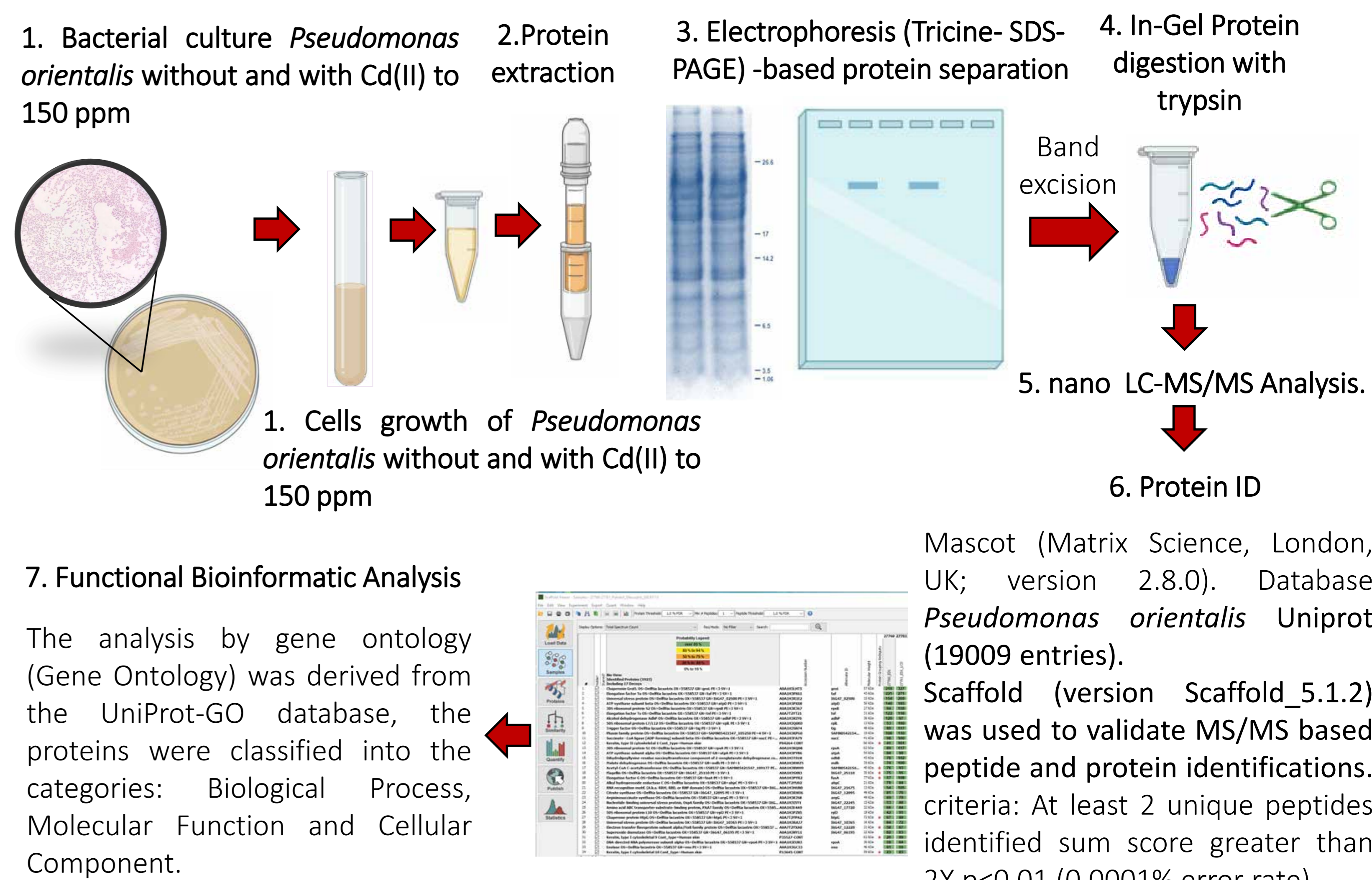


## 1. INTRODUCTION

Cadmium is considered a heavy metal that has effects on human health and also on ecosystems. In the soil, it reduces fertility and agricultural productivity. Bacteria have different stress tolerance mechanisms due to the presence of this metal, including the production of siderophores, proteins and exopolysaccharides. The objective of this study was to identify *Pseudomonas orientalis* B06CM strain [1] proteins in response to cadmium using nano LC/MSMS proteomic analysis of the bacterial extract with and without cadmium at a concentration of 150 ppm. The bioinformatic analysis of the proteins was carried out with the Gene Ontology (GO) annotation from the UniProt database, which allowed the protein to be classified into three categories such as *Molecular Function*, *Biological Process* and *Cellular Component*. These findings contribute to the fulfillment of sustainable development objectives 3 and 15.



## 2. MATERIALS AND METHODS

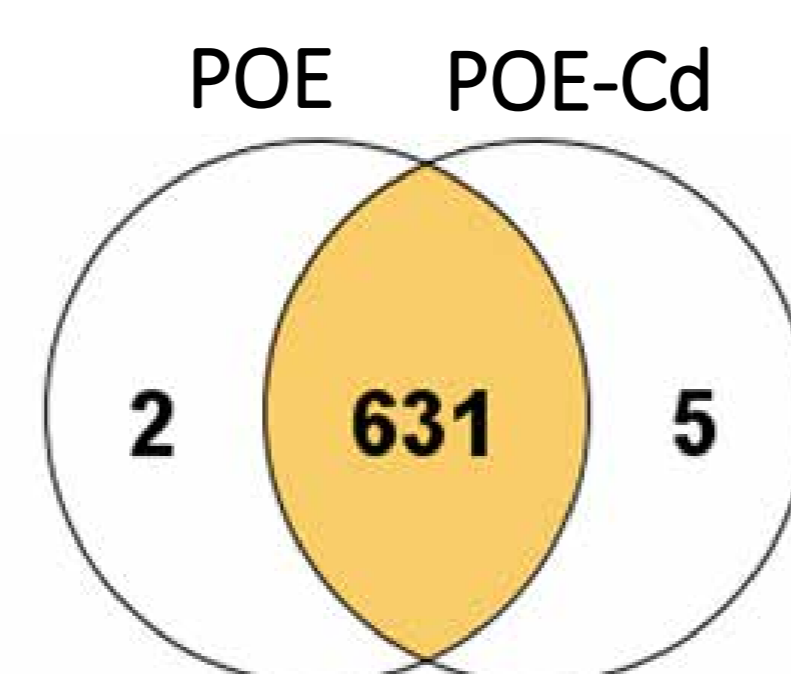


## 3. RESULTS AND DISCUSSION

### Protein Identification

The results obtained allowed us to identify 5 differentially present proteins, which may be related to the effect of tolerance on the growth of bacteria in the presence of cadmium as shown in figure 1.

**Figure 1.** Venn diagram provides an overview of key proteins of *Pseudomonas orientalis* extract without (POE) and with Cd(II) to 150 ppm (POE-Cd).



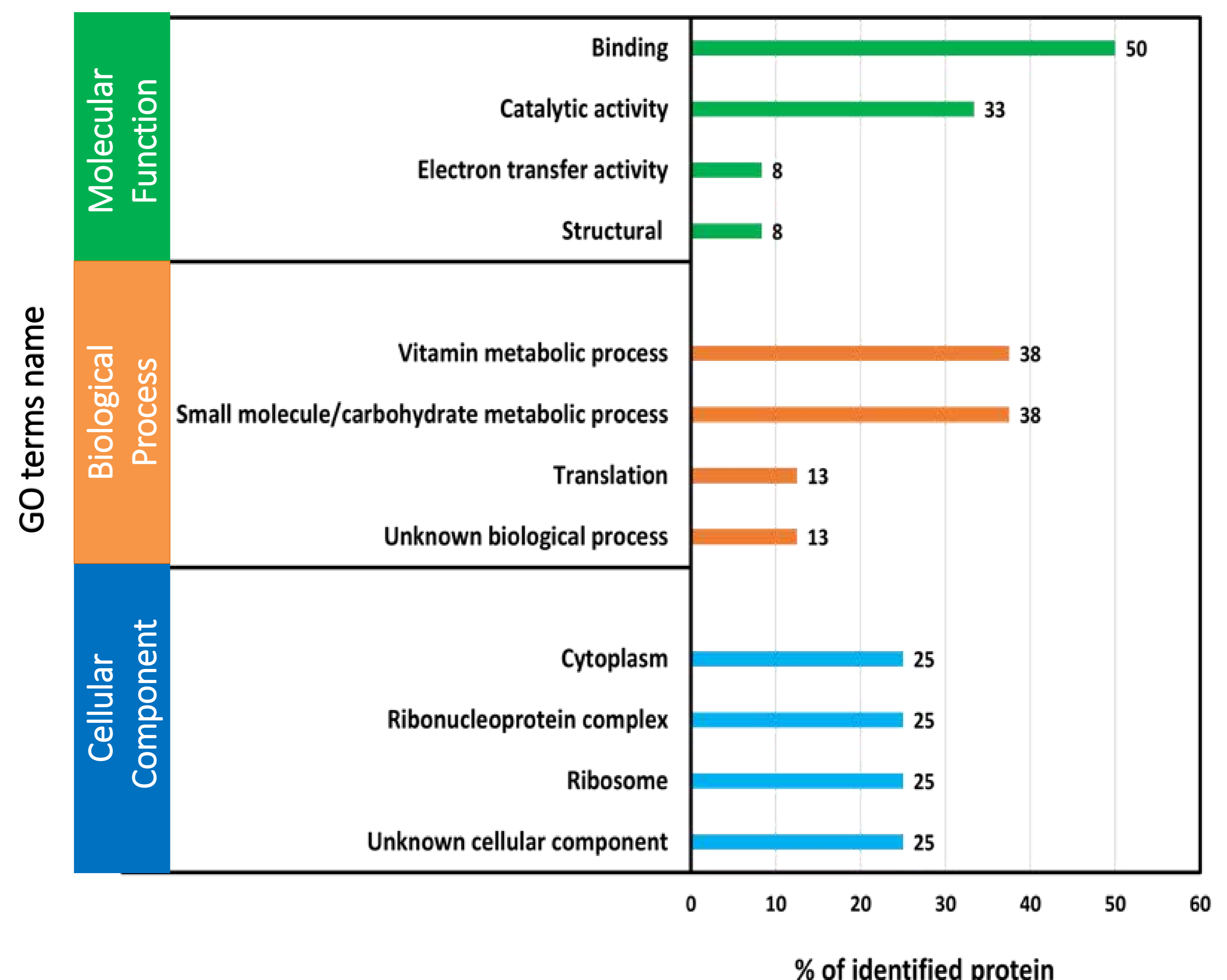
**Table 1.** Identified proteins of *Pseudomonas orientalis* extract with Cd possibly associated with the response to this metal (green) and both extract involved in the Plant Growth Promotion of by LC-MS/MS

Activity	Identified protein	Entry name UniProt	Molecular mass (kDa)
Tolerance in presence of cadmium	4-hydroxytetrahydrobiopterin dehydratase	A0A2L0S3R6	46
	4-hydroxythreonine-4-phosphate dehydrogenase	A0A1H2G0Q6	35
	50S ribosomal protein	A0A4Q7D568	5
	Formyltetrahydrofolate deformylase	A0A0R2ZXH8	32
	Ferredoxin	A0A0R3A2T1	12
Phosphate solubilization	dITP/XTP pyrophosphatase	A0A3G7X6U5	21
	Exopolyphosphatase	A0A0R3A3Q0	56
	Inorganic pyrophosphatase	A0A0R2ZTP5	19
Nitrogen fixation/Nitrogen ciclation	Cysteine desulfurase	A0A1H2FJN3	45
	Nitrogen regulatory protein P-II family	A0A0R2ZXC0	12
Sulfur metabolism	Sulfate ABC transporter ATP-binding protein	A0A0R2ZPQ3	37
	Sulfite reductase	A0A2L0R968	62
	Sulfate transport system substrate-binding protein	A0A1H2I5V4	37
GSH biosynthesis/ Metabolisms	Glutathione S-transferase	A0A1H2EYI0	23
	S-(Hydroxymethyl)glutathione dehydrogenase / alcohol dehydrogenase	A0A1H2HTS8	39
Siderophore Biosynthesis	Glutathione synthetase	A0A2L0S3Q2	35
	Bacterioferritin	A0A3G7WTM2	20
	Ferric uptake regulation protein	A0A0R2ZTQ2	15
	Chorismate synthase	A0A0R3A5P1	39
	Bifunctional chorismate mutase/prephenate dehydratase	A0A4Q7D396	40
Synthesis of the phytohormone indole acetic acid	Anthranilate synthase component I	A0A3G7X759	54
	Anthranilate synthase, component II	A0A3G7XNG7	22
	Tryptophan synthase beta chain	A0A3G7WSN2	45
	Anthranilate phosphoribosyltransferase	A0A0R2ZYL9	37
	Indole-3-glycerol phosphate synthase	A0A1H2G078	30
Oxidative stress response	Superoxide dismutase	A0A0R2ZYT5	22
	Catalase	A0A1H2FY57	54
	Thiol peroxidase	A0A0R3A1L2	18
	Alkyl hydroperoxide reductase C	A0A0R2ZU27	22
	Alkylhydroperoxidase AhpD domain protein	A0A3G7X046	20
	Alkyl hydroperoxide reductase C	A0A0R3A3V0	20
	Thioredoxin peroxidase	A0A1H2HY76	17
	Alkyl hydroperoxide reductase	A0A3G7X6Y1	24

### Functional Bioinformatic Analysis

Furthermore, approximately 30 common proteins were identified in the two bacterial extracts involved in the activities of nitrogen fixation, phosphate solubilization, sulfur metabolism, siderophore production, synthesis of the phytohormone indole acetic acid, metal resistance, exopolysaccharide biosynthesis and oxidative stress response (Table 1).

**Figure 2.** Gene Ontology (GO) classification of *Pseudomonas orientalis* proteins in presence to Cd(II) stress in the categories: Biological Process, Molecular Function and Cellular Component.



These proteins are involved with metalloproteins or proteins binding to different molecules (50%), catalytic activity (33%). In *Biological Processes* involved in metabolic processes of vitamins (38%) and small molecules or carbohydrates (38%). Regarding the Cellular Component, most proteins are part of the cytoplasm, ribosome and ribonucleoprotein complex (Figure 2).

## ACKNOWLEDGMENTS

We thank to the University of Tolima for its financial support under the research project "Proteomic analysis of protein extracts obtained from a cadmium-tolerant bacterial strain and its removal capacity using a bioadsorbent" code: 470121.



## REFERENCE

1. Ortiz Ortiz, J. C. ; Ramirez, R. A. ; Pulido, X. ; Varon López, M. 2021. Evaluación de la tolerancia a cadmio y plomo y su capacidad promotora de crecimiento vegetal de microorganismos aislados de relaves mineros . Memorias XXX Reunión Latinoamericana de Microbiología V Conferencia Latinoamericana de Microorganismos Promotores del Crecimiento Vegetal.



## CONCLUSION

The identification and functional classification of proteins in extracts of *Pseudomonas orientalis* with and without cadmium associated with plant growth promoting traits, make it a future candidate to potentially be used as a bioinoculant in contaminated soils.