of degrading caprolactam was isolated from soil and designated as RC-2. The performance of RC-2 in biodegradation of caprolactam was evaluated using free and immobilized bacterial cells (prepared using magnetically responsive gellan and alginate gels via ionotropic gelation) and biodegradability of caprolactam was evaluated by cultivating them in a synthetic medium (50 ml) in 250 ml Erlenmeyer flasks containing caprolactam (10 g/l) under shaken conditions (rpm: 180 at 30 ± 1 °C for 72 hours). The RC-2 exhibited nearly 90% degradation of caprolactam after 24 hours. Caprolactam was determined spectrophotometrically and 6-aminocaproic acid (6-ACA, i.e., caprolactam hydrolysate) was detected using thin layer chromatography. In conclusion, it can be mentioned that RC-2 is capable of degrading caprolactam at a concentration of 10.0 g/l without supplementation of nitrogen source and growth factors. This newly bacterial isolate RC-2 is competent to degrade caprolactam in both free and immobilized form. Moreover, the presence of 6-ACA in caprolactam hydrolysate is suggests the presence of lactamase within RC-2.

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Studying phytoremediation capacity of jojoba (*Simmondsia chinensis*) and sunflower (*Helianthus annuus*) in hydroponic systems

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In this study, Jojoba (*Simmondsia chinensis*) and sunflower (*Helianthus annuus*) as oilseed plants were tested phytoremediation potential. Phytoremediation capacity of Jojoba (*S. chinensis*) AA-5 and Sunflower (*H. annuus*) AS-508 were investigated in a hydroponic system. We examined Jojoba AA-5 and Sunflower AS-508 for their ability to accumulate Cadmium (Cd^{2+}) and Nickel (Ni^{2+}) heavy metals. We also examined Cd^{2+} and Ni^{2+} accumulation by *S. chinensis* AA-5 with comparison *H. annuus* AS-508, in a hydroponic system. For the experimental study, Jojoba AA-5 and Sunflower AS-508 were left for until sprouting in NFT (Nutrient Film Technique) and then transferred in to the heavy metal solutions that prepared at the concentration of 1, 5 and 7 ppm at pH 7.0 for Ni and Cd for 96 hours. The heavy metal concentrations were analyzed with AAS (Atomic Absorption Spectrophotometry) and found that nickel was the most accumulated element in the Jojoba AA-5 and Sunflower AS-508, with 16.53% and 19% respectively. Both species were accumulated to the highest levels of 1 ppm under the experimental conditions. Maximum Cd accumulation was achieved at 3.1% in Sunflower (*H. annuus*) AS-508.

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Biodegradation of naproxen by *Aspergillus niger* and identification of some intermediates

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The pharmacologically active organic micro pollutants and their metabolites has been detected in surface, ground, and waste water even in drinking water. The presence of these micro pollutants in aquatic environments has received more attention recent years because of their potential toxic effects. Naproxen is a propionic acid derivative nonsteroidal anti-inflammatory drug which is commonly used for reduction of pain, fever and inflammation. After naproxen intake, mother compound and its metabolites excreted with urine and feces. Because of its extensive use as a nonprescription drug, naproxen has been detected in the aquatic environments range from ng L^{-1} to μg L^{-1}. The ascomyceteous fungus *Aspergillus niger* could almost completely degrade (≥94%) 50 mg L^{-1} naproxen within 48 hours incubation. According to LS–MS data, two main metabolites O-desmthylnaproxen and 7-hydroxynaproxen were formed after 48 hours incubation period.

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Biodesulfurization of DBT by a hyperthermophilic archaeon *Sulfolobus solfataricus* P2

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Combustion of fossil fuels leads to the atmospheric emission of sulfur oxides that contribute to acid rain. Significant quantities of sulfur (up to 70%) in petroleum is found as recalcitrant heterocyclic organosulfurs [dibenzothiophene (DBT) and substituted DBTs]. Current sulfur removal processes involve hydrodesulfurization, which requires high temperatures and pressure for efficient catalysis. Biodesulfurization is an alternative method for oil and coal industry offering low costs and relatively easy operating conditions. The present study describes the usage of a hyperthermoacidophilic archaeon *S. sulfotaricus* P2 in the utilization of sulfur compounds from variety of organic and inorganic compounds at high temperatures, between 75 and 85°C and low pH, 3.0. To establish optimal sulfur free conditions, carbon sources containing arabinose, ethanol, glucose, mannose and mannitol have been employed to find the most suitable sources. Growths on the sulfur sources such as DBT, dibenzothiophene sulfone, BT, 4,6-dimethyldibenzothiophene, sodium sulfite, potassium disulphite, and potassium persulphate were investigated. 0.3 mM of all sulfur supplements except DBT led to increases in the growth rate from 1.35 to 2.0-fold. Further investigations revealed the maximum DBT tolerance as 0.1 mM. It was found that 88.5% of DBT was consumed and maximum desulfurization rate was obtained as 1.23 μmol 2-HBP $hour^{-1}$ g DCW^{-1} within 16.5 hours. Our results also revealed that DBT sulfone consumption is the rate limiting step in the overall DBT usage process for *S. solfataricus*. To the best of our knowledge,

this is the first report showing the DBT desulfurization kinetics analysis of *S. solfataricus*.

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Decolorization of doracryl blue and astrozon red by *Chiloscyphus polyanthos*

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Dyestuffs used in textile industry are highly coloured and disposal of wastes caused to damaged environmental problems. Liverworts with different structures are quite a large role in the realm of plants. In this study the decolorization capacity of *Chiloscyphus polyanthos* (Erciyes Mountain — Kayseri Turkey) was determined for Doracryl Blue and Astrozon Red was taken from BİRKO Co. in Niğde. Decolorization of textile dyes by *C. polyanthos* was studied as a function of initial pH and initial dye concentration. The optimum pH value was determined as pH 6 for Doracryl Blue and pH 4 for Astrozon Red by the yield of decolorization percentage. Decolorization capacity of *C. polyanthos* for Doracryl Blue was established as 96.44%, 97.54%, 97.67%, 97.68%, 97.65% for 100, 200, 300, 400, 500 ppm initial dye concentration sequentially. Furthermore the decolorization capacity of *C. polyanthos* for Astrozon Red was determined as 92.60%, 97.45%, 98.05%, 98.22%, 98.42% for 100, 200, 300, 400, 500 ppm initial dye concentration sequentially. Based on these results the *C. polyanthos* could be used for decolorization of Doracryl Blue and Astrozon Red because of highly removal capacity of dye.

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Enzyme and Protein Engineering

Engineering bispecificity into a single albumin-binding domain aimed for drug targeting and in vivo half-life extension

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During the past 15 years antibodies have been established as the primary affinity proteins in cancer therapy. More recently, promising alternative scaffolds of both immunoglobulin- and nonimmunoglobulin origins have gained an increased interest. Alternative molecular formats may provide an improved stability and solubility, cost-efficient production and ease of manipulation. One main drawback with antibodies, particularly in solid tumor targeting applications, is their large size, which impairs their vascular permeability and tumor penetration capability. Smaller binding proteins often have a better tissue penetration, but their small size also results in a rapid renal clearance and, thus, a shorter half-life. To circumvent the limitations of antibodies and simultaneously provide very small single-domain proteins with long half-life, we have engineered a 46 amino acid albumin-binding domain as a scaffold for bispecific affinity molecules. Albumin-binding is known to extend the half-life in vivo and by diversification of the non-albumin binding side of this three-helix bundle domain, followed by display of the resulting library on phage particles or on cells, bispecific single-domain proteins have been isolated. Following initial proofs of concept, low nanomolar affinity binders to cancer-associated epidermal growth factor receptors with very high affinities for human serum albumin accommodated in the same molecules, have been selected, characterized and affinity matured. For affinity-maturation a novel microbial cell-display platform and multi-color flow-cytometric cell sorting has been utilized. These novel molecules represent promising candidates for further development into potent inhibitors of cancer signaling and at the same time approach the size limit for structured bispecific protein domains.

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Degradation of important food ingredient (pectin) using polyacrylamide gel entrapped pectinase for continuous use

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Pectinase is a complex group of enzymes that degrade pectin, a complex polysaccharides mostly found in plants into simpler one galacturonic acid and have been used in various industrial processes including fruit juice extraction, textile processing and bioscouring of cotton fibers, retting of plants fibers, waste water treatment, coffee and tea fermentation and oil extraction. The current study deals with the entrapment of pectinase within polyacryalmide gel for continuous industrial process. The entrapment of pectinase within polyacryalmide gel is done through the polymerization of gel containing acrylamide (monomer) and N,N′-methylenebisacrylamide (cross linker) in the presence of enzyme. Maximum immobilization of enzyme was obtained with concentration of 9.5% and 0.5% of acrylamide and N,N′-methylenebisacrylamide, respectively. The catalytic properties and kinetic parameters of immobilized pectinase were compared with free enzyme. It was found that free and immobilized pectinase showed maximum pectinolytic activity at 45°C and pH 10. The Michaelis–Menten kinetic behavior of immobilized and free pectinase was determined by using different concentration of pectin. The immobilized pectinase showed excellent thermal stability against different temperatures ranging from 30°C to 50°C. The immobilized enzyme exhibited great reusability and retained 80% of its original activity after three times of reusing in batch reactions.

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Heterologous expression of a viral coat protein facilitates long-distance movement of a recombinant protein expressing virus vector

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Tomato bushy stunt virus (TBSV) is able to move cell-to-cell in absence of coat protein (Tcp) expression and spread through plants in some experimental hosts, but in general the presence of Tcp is important for systemic invasion. The objective of current study was to determine complementation of Tcp by its heterologous expression from an infectious Potato virus X vector upon co-infection with a TBSV mutant (T-GFP) in which the Tcp gene was replaced with that for GFP. As controls, T-GFP was inoculated either alone or