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الملخص العربي

استهدفت هذه الدراسة عزل بعض السلالات الفطرية المقاومة للمعادن من التربة و تقييم قدراتها على التخلص الحيوي من ايونات الكادميوم و النحاس و الرصاص والزرنيخ ومن ثم دراسة الظروف المناسبة لتحقيق افضل النتائج. كما تمت مقارنة التجمع الحيوي لهذه المعادن في خلايا الفطريات المعزولة والامتصاص الحيوي لها على سطح تلك الخلايا. وكذلك دراسة التأثيرات الفسيولوجية لهذه المعادن الثقيلة علي خلايا الخميرة. وتتلخص النتائج التي تم التوصل اليها كالاتي:

1. تم عزل اثنى عشر سلالة فطرية من التربة. وكذلك تم الحصول على فطر الخميرة من مخلفات شركة "حلو الشام" للمواد الغذائية.

2. تمت دراسة تأثير التركيزات المختلفة للمعادن الثقيلة على حيوية ونمو الخلايا المعزولة. وتم تقسيم تلك العزلات الي اربع مجموعات كالتالي: المجموعة أ والتي تمثل السلالات الميتة والمجموعة د والتي تمثل السلالات الاكثر مقاومة لتك المعادن الثقيلة واخيرا المجموعتان ب و س والتي تمثل السلالات المعتمدة على نوع وتركيز المعدن في مدى حيويتها ونموها.

3. السلالات الثمانية (والتي تمثل المجموعات ب و س و د) تم اختبار قدرتها على ازالة ايونات الكادميوم و النحاس و الرصاص والزرنيخ من الوسط الغذائي (بواسطة عملية التراكم الحيوي) وكذلك من المحلول الملحي لها (بواسطة عملية الامتصاص الحيوي).

4. في عملية التراكم الحيوي: جميع الفطريات التي تم اختبارها كانت قادرة على النمو تحت تأثير 100 ملجم/لتر كادميوم و نحاس ورصاص وزرنيخ ماعدا فطر الاسكوبيولريوبسيس الذي تم تثبيطه بالكامل تحت تأثير 100 ملجم/لتر رصاص وزرنيخ. هذه المقاومة تختلف من فطر لاخر وهذا الاختلاف ينعكس على سعة التراكم الحيوي حيث ان الفطر الاعلى مقاومة للمعادن الثقيلة يمتلك اعلى سعة للتراكم الحيوي لتك المعادن.

5. اثبتت التجربة ان افضل فطر لازالة عنصري الكادميوم والنحاس بواسطة عملية التراكم الحيوي هو الاسبرجلس نيجر بينما كان فطر الخميرة (السكارومايسس سريفيسا) هو الافضل في ازالة الرصاص والبنسليوم كريزوجينم هو الافضل في ازالة الزرنيخ بواسطة نفس العملية. وكانت نسب هذه الازالة 70.74% و 84.3% و 73.98% و 61.89% ل الكادميوم و النحاس و الرصاص والزرنيخ على التوالي بعد اربعة عشر يوم من التحضين (حيث ان التشبع تم في اول اربعة ايام).

6. في عملية الامتصاص الحيوي: تم استخدام الخلايا الجافة والميتة للكتلة الحيوية للفطريات ووجد ان فطر الاسبرجلس نيجر وتيرس (الخلايا الجافة والميتة) كان افضل السلالات في ازالة جميع المعادن ماعدا الرصاص الذي تم ازالته افضل بواسطة الخلايا الجافة للسكارومايسس وكذلك الكادميوم والنحاس تم ازالتهم افضل بواسطة الخلايا الميتة للبنسليوم

7. عنصر الزمن في عملية الامتصاص الحيوي ليس ذو قيمة كما في عملية التراكم الحيوي للمعادن لانها لا تعتمد على التمثيل الغذائي لخلايا الفطريات وبالتالي كانت الاسرع حيث ان تشبع الفطريات بالمعادن لم يستغرق اكثر من ست ساعات او في حدود اربع الي ست ساعات.

8. جميع السلالات الفطرية استطاعت ادمصاص كميات محددة من عناصر الكادميوم و النحاس و الرصاص والزرنيخ بواسطة عملية الامتصاص الحيوي. واختلفت النتائج وفقا لنوع الفطر ونوع المعدن وكذلك تركيب الجدار الخلوي للخلية الفطرية.

9. تم اختيار فطر الخميرة (السكارومايسس سيرفيسا) لتكملة باقي التجارب وذلك لانه اعطى نتائج مرضية في المرحلة السابقة علاوة على انه سهل الحصول عليه بكميات كبيرة ومن الممكن استغلال مخلفات المصانع الغذائية في الحصول على كميات كبيرة منه. كما انه يلقى قبول من العامة لو تم تطبيقه عمليا واخيرا يمكن استخدامه في دراسة مستقبلية على المستوى الجزيئي لمعرفة التفاعل الدقيق الذي يحدث بين المعدن والخليه.

10. في عملية التراكم الحيوي: نوع الوسط الغذائي و الاس الهيدروجيني وفترة التحضين وتركيز المعدن كلها تؤثر على نمو خلايا السكاروميسس وكذلك على سعته في ازالة هذه المعادن. اقصى نمو لخلايا السكاروميسس كان على الوسط الغذائي السائل (الجلكوز – ببتون) عند اس هيدروجيني 5 لمدة اربعة ايام عند 27 درجة مئوية. زيادة تركيز المعادن الثقيلة في تلك الظروف يؤدي الي نقصان النمو وكذلك نقصان القدرة على ازالة تلك المعادن بواسطة عملية التراكم الحيوي.

11. في عملية الامتصاص الحيوي: تم معاملة خلايا الخميرة فيزيائيا وكيميائيا لزيادة قدرتها على التخلص من المعادن الثقيلة بواسطة عملية الامتصاص الحيوي. كانت اعلى قيم الامتصاص الحيوي للكادميوم و الرصاص والزرنيخ بواسطة خلايا الخميرة المعاملة بالايثانول هي 6.78 و 7.54 و 6.12 مجلم/ جم على التوالي عند اس هيدروجيني 5 اما اعلى قيمة للامتصاص الحيوي للنحاس كانت بواسطة خلايا الخميرة المعاملة بهيدروكسيد الصوديوم هي 8 ملجم/جم عند اس هيدروجيني 5. اثبتت التجربة ان افضل اس هيدروجيني يوفر اعلى امتصاص حيوي للكادميوم و الرصاص والزرنيخ هو 5 بينما كان الاس الهيدروجيني 6 هو الافضل للكادميوم حيث ارتفعت نسبة الامتصاص من 6.78 الي 7.87 ملجم/جم.

12. زيادة تركيزات ايونات الكادميوم و النحاس و الرصاص والزرنيخ يكون مصحوب بزيادة في عملية الامتصاص الحيوي التي يلاحظ انها عملية تتم بسرعة خصوصا في اول ساعتين ومن ثم تتم عملية تشبع الجدار الخلوي بالمعادن في الفترة المتبقية.

13. بالاضافة الي ذلك فان المعادن المدمصة على سطح خلايا الخميرة يمكن ازالتها بحمض النيتريك وغسيل الخلايا بهدروكسيد الصوديوم ومن ثم اعادة استخدام تلك الخلايا في دورات اخرى لعملية الامتصاص الحيوي.

14. استخدام ايونات الكادميوم و النحاس و الرصاص والزرنيخ بمختلف التركيزات في الوسط الغذائي لخلايا الخميرة يؤثر على منحنى النمو لتلك الخلايا ويؤدي الي تثبيط وتقليل انقسام الخلايا في مختلف مراحل النمو. مقدار التثبيط يختلف باختلاف نوع المعدن ودرجة سميته على الخلية. بصفة عاملة فان زيادة تركيز المعادن تؤدي الي نقص المنو وكذلك نقص الامتصاص حيث نلاحظ انخفاض منحنى النمو.

15. بزيادة تركيز ايونات الكادميوم و النحاس و الرصاص والزرنيخ فان الحمض النووي والبروتين الكلي والدهون الكلية والكربوهيدرات الكلية لخلايا الخميرة تقل. وهذا التأثير السلبي يختلف وفقا لنوع المعدن ومدى سميته لتلك المكونات.