

مؤشرات المزارعين نحو التنمية الزراعية الريفية المستدامة في مديرية السبرة ، محافظة إب

(د.عبدالكريم سعيد ، د.خالد الحكيمي، د.عبدالحدي،

د.إسماعيل الحداد)

أستاذ الاقتصاد والإرشاد الزراعي المساعد، كلية الزراعة، جامعة إب

أ. أحمد عبده سيف اليماني

مدرس، الاقتصاد والإرشاد الزراعي، كلية الزراعة، جامعة إب

الملخص :

استهدف البحث التعرف على اتجاهات مزارعي عزلة عينان ؛ مديرية السبرة من محافظة إب نحو التنمية الزراعية الريفية المستدامة وعلى بعض خصائصهم الشخصية والاجتماعية والاقتصادية.

وقد جمعت البيانات عن طريق الاستبيان بالمقابلة الشخصية لعينة مكونة من 300 مزارع مثلت حوالي 34.3% من حجم مجتمع البحث. استخدم فيه كل من مقياس النزعة المركزية والتشتت والاختلاف لتحليل بيانات البحث باستخدام برنامج التحليل الإحصائي SPSS ، و بينت النتائج أن اتجاهات المزارعين نحو التنمية الزراعية الريفية المستدامة إيجابية إلى حد كبير، حيث بلغت 72.2%.

وفيما يتعلق بالخصائص الشخصية والاقتصادية والاجتماعية لمزارعي المنطقة، تبين أن عمر المزارع متوسط إلى مرتفع، إذ بلغ المتوسط الحسابي 46.2 وارتفع المستوى التعليمي، حيث بلغت نسبة الأمية 25%، وان 54.6% من المزارعين.

تشكل الزراعة المهنة الرئيسية لهم، رغم انخفاض مستوى الدخل من الزراعة إذ بلغ متوسط الدخل الشهري للفرد 15.4 ألف ريال.

وقد أوصت الدراسة بضرورة التوسع في إقامة الحواجز المائية في المنطقة وتزويد المزارعين بالتقنيات الحديثة في الري بتكاليف تشجيعية، بالإضافة إلى تنمية قدرات السكان ورفع مستوى التأهيل والتدريب لديهم بإقامة الدورات التدريبية وتنفيذ مشاريع تنمية مستدامة في المنطقة.

المقدمة :

يتزايد الاهتمام بالزراعة المستدامة في دول العالم المختلفة منذ ثمانينات القرن الميلادي الماضي، كنتيجة لظهور بوادر التأثيرات السلبية للزراعة الصناعية على البيئة وصحة المستهلكين وأمن الحياة الاجتماعية للمزارعين وسكان الريف. إذ بدأ واضحا للمهتمين بقضايا التنمية والبيئة وصحة الإنسان أن الثورة الخضراء **Green Revolution** التي ساهمت في توسع الإنتاج الزراعي تسبب في تلوث البيئة عبر استخدام العديد من المدخلات الصناعية في الزراعة كالأسمدة والمبيدات، وتؤدي إلى تدهور التربة الزراعية وتعريضها من خلال المبالغة في استخدام المعدات الثقيلة في العمليات الزراعية، وإلى تغيير النمط التقليدي الزراعي وهجرة سكان المناطق الريفية والزراعية والنزوح إلى المدن، بالإضافة إلى الاستنزاف الجائر للموارد الطبيعية.

وبهذا يتضح عدم قدرة نظام الزراعة المكثفة على الاستمرار في الإنتاج الزراعي بنفس المعدلات العالية و في الوفاء باحتياجات الناس من الغذاء السليم بالإضافة إلى صعوبة الاستمرار في توفير متطلبات هذا النظام الزراعي المكثف و المكلف ماديا وبيئيا. ولقد دفع ذلك العلماء إلى التفكير في نظام زراعي متوازن يكفل الوفاء بمتطلبات الأجيال الحالية والمستقبلية في أحقية الحصول على الغذاء الصحي والبيئة النقية والموارد الطبيعية المصانة و المنتجة.

ومن هنا نشأ الاهتمام بالتنمية الزراعية المستدامة التي أصبحت الآن تمثل محورا جوهريا في السياسة الزراعية للعديد من الدول (الشنيفي، 2009).

من هنا اهتمت الحكومة اليمنية بالقطاع الزراعي لدوره الحيوي في تأمين الاحتياجات الغذائية للمواطنين. وقد قامت بإعداد الخطة الخمسية الأولى (1996 - 2000) والثانية (2001 - 2005) والهادفة إلى تحسين الظروف الاقتصادية والاجتماعية للمواطنين، وبخاصة العاملين في مجالات الإنتاج الزراعي والذي أدى بدوره إلى قيام مشاريع زراعية مختلفة في مجال إنتاج الفاكهة ومحاصيل الخضار والتي غطت بعضها احتياجات السوق المحلية وصدرت إلى الخارج (كتاب الإحصاء الزراعي، 2010). إلا أنه رافق هذه التنمية الزراعية ظهور بعض الآثار السلبية المتعلقة بالبيئة والموارد الطبيعية، نتيجة التكتيف الزراعي باستنزاف المياه والاستخدام العشوائي للمبيدات الكيماوية (الخطة الخمسية الثانية 2001 - 2005)

مفاهيم متعلقة بالاستدامة :

الاستدامة تعني بقاء الشئ والجهد المتواصل كما هو ، أما في الزراعة فان الاستدامة تعني القدرة على استمرار الإنتاج مع المحافظة على الموارد الطبيعية (صرصور، 1999).

وتعرف التنمية الزراعية المستدامة بأنها الزراعة القادرة على إدارة الموارد بشكل ناجح لتلبية الحاجات البشرية المتغيرة، مع صيانة وتحسين البيئة والموارد الطبيعية والمحافظة على سلامتها (صرصور، 1999).

وتعرفها منظمة الزراعة والأغذية الدولية (FAO, 1999) بأنها إدارة وصيانة قاعدة الموارد الطبيعية والتهئية إلى التغيير التقني والمؤسسي لما يضمن تحقيق الاحتياجات الإنسانية وبصورة مستمرة للأجيال الحالية والمستقبلية وتصون الأرض والمياه والتنوع الوراثي للنبات والحيوان، كما إنها غير ضارة بيئياً ومناسبة فياً وقابلة للتطبيق اقتصادياً ومقبولة اجتماعياً .

وبغض النظر عن التعريف فإن أي نظام تنموي زراعي مستدام عليه أن يلبي الشروط التالية مجتمعة: السلامة البيئية، الجدوى الاقتصادية، العدالة الاجتماعية والقدرة على التكيف (صرصور، 1999).

وترى المنظمة العربية للتنمية الزراعية أن التوجهات الرئيسية للتنمية العربية المستدامة للعقدين القادمين تركز على المياه كمحدد رئيسي للتنمية الزراعية المستدامة، تنمية وحماية الأراضي الزراعية، استغلال الموارد الزراعية من منظور تكاملي، التطوير والتحديث التقني للزراعة، أوليات التنمية القطاعية، بناء القدرات وتنمية القدرات البشرية، الاستثمار الزراعي المشترك، تنشيط التجارة الزراعية العربية، كمحرك للتنمية، التكيف مع المتغيرات الإقليمية والدولية المعاصرة والمستقبلية، المساهمة في ازدهار الريف، مشاركة المجتمع المدني والقطاع الخاص. (المنظمة العربية للتنمية الزراعية، 2007).

ويدور منهج التنمية الزراعية المستدامة حول المحور الرئيسي لها وهو الإنسان، وذلك من خلال المشاركة الفاعلة في وضع البرامج والسياسات ودعم الجهود الرائدة وبناء قدرات المجتمعات المحلية الريفية والفئات المحرومة وغير ذلك من أصحاب الشأن من اجل الاعتماد على نفسها(أبو شريحة، 2008).

ولا بد أن يقوم بناء القدرات في جميع شرائح المجتمع وخاصة المجتمع الريفي على التعليم من قراءة وكتابة ومهارات حياتية ومحو أمية سكان الريف بجميع شرائحها وتركيبها السكانية، وهذا

الأمر يحتاج إلى جهد كبير ومتواصل (الحكيمي، 2008).

وقد اهتمت الحكومة اليمنية بتنمية القطاع الزراعي في الفترة الأخيرة من خلال بعض المشروعات التي تضمنتها الخطة الخمسية الأولى من عام 1996 - 2000م والخطة الخمسية الثانية 2001 - 2005، مما أدى إلى تمكن القطاع الزراعي من تحقيق معدل نمو سنوي 5٪، والمساهمة في توفير جزء كبير من احتياجات السكان من المواد الغذائية، بل استطاع القطاع الزراعي تحقيق اكتفاء ذاتياً في معظم الخضروات والفواكه وتصدير كميات كبيرة منها. كما قامت بتنفيذ العديد من الدورات التدريبية شملت معظم أنشطة وجوانب القطاع الزراعي (وزارة التخطيط والتعاون الدولي، 2006).

كما عملت الحكومة على رسم وتنفيذ عدد من السياسات وخطط العمل المرتبطة بالتنوع الحيوي والتنمية المستدامة مثل الاستراتيجية الوطنية للمياه وسياسة مساقط المياه والخطة الوطنية لحماية البيئة والخطة الوطنية لمكافحة التصحر (الهيئة العامة لحماية البيئة، 2004). ولقد تم اختيار عزلة عينان في مديرية السبرة من محافظة إب، مجتمعا لإجراء الدراسة عليها، للأسباب الآتية:

1. قربها من مركز المحافظة وتوفر الأراضي الزراعية والموارد المائية.
2. قربها من الطرق الرئيسية المسفلتة وقرب قرى العزلة من بعضها ومن الأراضي الزراعية.
3. إمكانية تبني المنطقة لجعلها نموذجاً لبقية العزل من خلال تبني إقامة مشروعات تنمية زراعية مستدامة.

أهداف الدراسة:

1. التعرف على بعض الخصائص الشخصية والاجتماعية والاقتصادية لمواطني عزلة عينان وأثرها على التنمية الزراعية الريفية المستدامة.
2. التعرف على اتجاهات مزارعي عزلة عينان نحو التنمية الزراعية الريفية المستدامة.

منهجية البحث:

أجريت الدراسة على عزلة عينان في مديرية السبرة من محافظة إب، الواقعة في الجزء الجنوبي الشرقي لمدينة إب، على بعد حوالي 25 كم من مركز المحافظة. ويرجع اختيار هذه المنطقة للأهمية الزراعية لها والمتعلقة بتوفر الأراضي الزراعية والمياه، إضافة إلى قربها من مركز المحافظة والطرق المسفلتة والذي يمكن أن يجعلها مركزاً ونموذجاً لتحقيق التنمية المستدامة في مناطق ريفية أخرى.

يتكون مجتمع الدراسة من جميع أسر المنطقة البالغ عددهم 875 أسرة (كتاب إحصاء المساكن والسكان 2004). ونظراً لكبر مجتمع الدراسة فقد عمد إلى أخذ العينة بالطريقة العشوائية البسيطة **Simple Random Sampling** بلغ قوامها 300 أسرة بواقع 34.3 %.

جمع البيانات وتحليلها :

اعتمد البحث على الاستبانة بعد المقابلة الشخصية مع مزارعي المنطقة، بحيث تم تصميم الاستبانة التي اشتملت على جميع التساؤلات والاستفسارات التي تحقق أهداف البحث وأغراضه. وتم اختبار الصدق للاستبانة بعرضها على أعضاء هيئة التدريس بقسم الاقتصاد والإرشاد الزراعي بكلية الزراعة، جامعة إب .

تم استخدام كل من مقياس التوسط او التمركز والتشتت والاختلاف باستخدام برنامج التحليل الإحصائي **SPSS**.

النتائج والمناقشة :

تم عرض 12 سؤالاً لتحديد المؤشرات الرئيسية لاتجاهات المزارعين المبحوثين نحو الزراعة المستدامة كما هو موضح في الجدول (1) كما يلي :

جدول (1) : ترتيب رغبة المبحوثين في إقامة مشاريع زراعية تنموية وفقاً للأهمية النسبية للمشاريع المقترحة

السؤال	عدد	%
إتباع الطرق الزراعية الحديثة لزيادة الإنتاج	257	85.7
التقليل من استخدام المبيدات الكيميائية	249	83.0
التقليل من استخدام الأسمدة الكيميائية	249	83.0
استغلال مخلفات الزراعة لإنتاج أسمدة عضوية	246	82.0
استغلال مخلفات الحيوانات لإنتاج غاز حيوي	242	80.7
مشروع تربية الدجاج	234	78.0
مشروع تربية الأغنام	205	68.3
زراعة الخضر البقولية المختلفة	201	67.0
مشروع تربية النحل	201	67.0
مشروع تربية وتسمين العجول	180	60.0
زراعة الفراولة.	176	58.7
إنشاء بستان لأشجار فاكهة مختلفة	158	52.7

أولاً: اتجاهات مزارعي عزلت عينان نحو التنمية الزراعية المستدامة :

تم عرض 12 سؤالاً صممت لقياس اتجاهات المزارعين الباحثين نحو التنمية الزراعية المستدامة وتم ترتيبها، وفقاً لأهميتها حسب الرغبة والميول نحو هذه المشاريع كما هو موضح بالجدول (1).

ويلاحظ أن اتجاهات المزارعين نحو وسائل تحقيق الزراعة المستدامة ايجابية حيث بلغت 72.2%. وعلى مستوى العبارات الفردية فقد تراوحت النسبة المئوية بين 52.7% كحد أدنى و 85.7% كحد أعلى. وسجلت عبارة "إنشاء بستان فاكهة مختلفة" أدنى نسبة مئوية بواقع 52.7% وعبارة "اتباع الطرق الزراعية الحديثة لزيادة الإنتاج" أعلى نسبة مئوية تليها عبارة "التقليل من استخدام المبيدات الكيماوية" بنسبة 83.0%. أما العبارات المتعلقة برغبة المزارعين بإقامة مشاريع زراعية تنموية مستدامة فكانت متراوحة بين ادني حد 52.0% وأعلى حد 78%.

إن موافقة المزارعين الباحثين على خطورة بقايا المواد الكيميائية على الفواكه والخضار والمحاصيل الحقلية على صحة المستهلكين، وعلى ترشيد استهلاك المياه في الزراعة باستخدام طرق الري الحديثة تمثل خطوة هامةً لأتجاه تبني الزراع لبعض تقنيات الزراعة المستدامة، ويتفق هذا مع ما توصل إليه (Norvell & Hamming, 1999). كما أوضح المزارعون الباحثون من خلال المقابلة الشخصية حاجتهم إلى برامج إرشادية لتدريبهم على أساليب الزراعة المستدامة والتي تُحافظ على التوازن بين الإنتاج الزراعي وسلامة البيئة وصحة الإنسان، ويتفق هذا مع ما توصل إليه (Kotile & Martin, 2000).

ومن خلال النظر إلى النسبة المئوية الكلية لاتجاهات المزارعين والبالغة 72.2% تبين أن هناك حاجة إلى إقامة برامج تدريبية وإرشادية للعمل على تغيير الاتجاهات السلبية لدى المزارعين لتبني التنمية الزراعية المستدامة وذلك بإدخال تقنيات زراعية من إتباع الطرق الزراعية الحديثة لزيادة الإنتاج وغيرها كما هو موضح في الجدول رقم (1) ومن ضمنها تقنيات الري الحديث وإدخال تقنيات حصاد المياه المتمثلة بإقامة السدود والحواجز المائية، لتوفير القدر الكافي من المياه لإقامة مشاريع تنموية زراعية في المنطقة.

ثانياً : الخصائص الشخصية والاجتماعية لمزارعي عزلت عينان :

يوضح جدول (2) الخصائص الشخصية والاجتماعية والاقتصادية للمزارعين الباحثين

والذي يتبين من خلاله أن حوالي ربع الباحثين (18.9%) تنتمي أعمارهم للفئة العمرية 46-50 عاما و 12.6% تنتمي أعمارهم للفئة العمرية 41-45 عاما، في حين بلغ متوسط العمر 46.2 سنة وغالبيتهم (88%) متزوجون. وقد بلغ الانحراف المعياري بين الفئات العمرية المختلفة 11.6 وبتباين 134.7.

ولقد تم سؤال العينة البالغ عددها 300 مزارع عن مستوى التعليم، أجاب على السؤال 108 زراع حيث بلغ نسبة التعليم الأساسي 22.6% والتعليم الثانوي 6.6% ونسبة التعليم الجامعي 6.6%. بينما كانت الإجابة على سؤال يقرأ ويكتب 33% وأمّي 25% من مجموع العينة المدروسة (جدول 2)، وهذا الأمر يجب أخذه في الاعتبار عند وضع البرامج الإرشادية الخاصة بالزراعة المُستدامة واستخدام طرق إرشادية متنوعة لتتلاءم مع التباين الواضح في المستويات التعليمية للزراع، كما يمكن الاستفادة من الزراع الحاصلين على شهادة ثانوية وجامعية بتدريبهم ليصبحوا المتبنين الأوائل لتقنيات الزراعة المُستدامة المختلفة.

كما تبين أن الزراعة تشكل المهنة الرئيسية للسكان بواقع 54.6%، بينما 22% مهنتهم الرئيسية غير زراعية (تجار، عمال، سائقين، مدرسين، موظفين) وبلغ نسبة الذين لم يجابوا 23.2%.

أما بالنسبة للدخل المزارعين فقد تبين أن مستوى دخلهم متدن جداً، حيث بلغ المتوسط الحسابي للدخل الشهري 15.4 (ألف ريال يمني) بتباين قدره 128.8. ووجد أن 3.33% يقل دخلهم الشهري من الزراعة عن 5000 (ألف ريال يمني)، و 5.67% يتراوح دخلهم الشهري بين 36-40 (ألف ريال يمني) (جدول 3)، وقد بلغ الانحراف المعياري بين فئات الدخل المختلفة 11.3.

ويمكن تفسير هذا التدني في مستوى الدخل إلى التخوف لدى المزارعين من إظهار الدخل الفعلي لهم وهذا كان واضحاً من النسبة الكبيرة التي لم تجاب منهم على هذا السؤال والبالغة 62%. وهذا على الرغم من اعتمادهم على زراعة القات، الذي يمكن أن يتخلى المزارع عن زراعته باعتماد برنامج مدرّوس تبني الدولة تعميم زراعات أخرى مهمة، تعوض قالمي أشجار القات الفارق من الدخل السنوي ولفترة محددة.

جدول (2) : الخصائص الشخصية والاجتماعية لمزارعي عزلة عينان (ن=300)		
النسبة المئوية للحاصلين على شهادة تعليمية من أرباب الأسر		
الصفة	العدد	%
أساسي	68	22.6
ثانوي	20	6.6
جامعي	20	6.6
لم يجب	192	64.0
النسبة المئوية لغير الحاصلين على شهادة تعليمية من أرباب الأسر		
يقرا ويكتب	99	33
أمي	75	25
لم يجابوب	126	42
الحالة الاجتماعية		
متزوج	264	88.0
أعزب	0	0.0
أرمل	5	1.6
مطلق	1	0.3
لم يجابوب	30	10.0
المهنة الأساسية		
زراعية	164	54.6
غير زراعية	66	22
لم يجابوب	70	23.3

عمر رب الأسرة		
%	العدد (F)	الفئة العمرية
1.3	3	16-20 سنة
2.5	6	21-25 سنة
8.4	20	26-30 سنة
9.7	23	31-35 سنة
10.9	26	36-40 سنة
12.6	30	41-45 سنة
18.9	45	46-50 سنة
10.5	25	51-55 سنة
10.9	26	56-60 سنة
14.3	34	60-65 سنة
100	238	

المتوسط الحسابي = 46.2، التباين = 134.7، الانحراف المعياري : 11.6

جدول (3) متوسط الدخل الشهري من الزراعة (ألف ريال يمني)		
%	العدد (F)	الفئة (بالآلاف الريالات)
3.33	10	1 - 5
16.67	50	6 - 10
4.67	14	11 - 15
4.67	14	16 - 20
1.00	3	21 - 25
1.33	4	26 - 30
0.67	2	31 - 35
5.67	17	36 - 40
38.00	114	

المتوسط الحسابي = 15.4، التباين = 128.8، الانحراف المعياري : 11.3

التوصيات :

استنادا إلى ما توصلت إليه هذه الدراسة من نتائج يمكن الخروج بالتوصيات الآتية :

1. التوسع في إقامة السدود والحواجز المائية في المنطقة لاستخدامها في الري وتغذية المياه الجوفية كون المياه تعتبر المحدد الرئيس للتنمية الزراعية المستدامة.
2. تزويد المزارعين بتقنيات الري الحديث (كالري بالتنقيط) وبتكاليف تشجيعية.
3. تنمية قدرات السكان ورفع مستوى التأهيل والتدريب لديهم من خلال إقامة الدورات التدريبية في مختلف المجالات الزراعية.
4. تنفيذ مشاريع تنمية مستدامة في المنطقة المبحوثة، نظراً لرغبة المزارعين في ذلك تبناها الدولة وبمشاركة المستفيدين.
5. تنظيم وتنفيذ حملات إعلامية مكثفة لتوعية الزُّراع بتقنيات الزُّراعة المُستدامة المختلفة.

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**Farmers' Attitudes Toward Sustainable Rural Agriculture
in Aynan privacy (Al Sabrah province), Ibb Governorate**

Abdul Kareem Saced, Khalid Al Hakimi, Abduh Al Haddi, Ismaeel Al Haddad,
Ahmed abduh Saif Al Yamany.

(Extension & Economics Dept, Plant Production Dept. Faculty of Agriculture
and Veterinary – Ibb University)

ABSTRACT :

The study aimed to study farmers' attitudes towards sustainable rural agriculture in Aynan privacy and to explore some of their socioeconomic characteristics.

Data were collected using a questionnaire, with a simple random sample of 300 farmers, representing 34.3 % of the study population. Percentages, mathematical means, Measures of Dispersion or Variation, Measures of Central Tendency were obtained using the SPSS statistical package.

The study revealed that the farmers generally have a positive attitude toward sustainable agriculture with a score of 72.2 %.

The research findings indicate that average farmer age was middle up to high 46.2 years, and farmers had high education level, only 25% were illiterate, and agriculture was a first job for 54.6 % of the respondents and the agricultural income of the farmers was as low as reaching 15.4 thousands YR.

It was recommend that extension and training programs related to sustainable agriculture should be planned and executed. Also building dams and introducing modern irrigation technology were recommend.

سلوك التشوه المعتمد على الزمن للسبيكة التي أساسها القصدير خلال عملية التحول

علي النخلاني⁽¹⁾ ، محمد عبد الحفيظ⁽¹⁾ ، خليل عزيمة⁽²⁾

⁽¹⁾ قسم الفيزياء - كلية العلوم - جامعة دمشق - سوريا

⁽²⁾ قسم علم المواد - كلية الهندسة الميكانيكية والكهربائية - جامعة دمشق - سوريا

خلاصة البحث:

يتناول هذا البحث دراسة سلوك الزحف للسبيكة الثلاثية Pb-61.9wt%Sn-2wt%Zn اعتماداً على الزمن ، حيث أجريت تجارب زحف إجهاد الشد الثابت عند إجهادات ثابتة تتراوح من 5,3 إلى 7,802 ميغا باسكال وعند مدى درجة حرارة من 363 إلى 433 كلفن. وخلصت الدراسة إلى أن معدل انفعال الزحف يزيد وزمن الزحف ينقص بزيادة الإجهاد المطبق ودرجة الحرارة. وأجري تحليل المساح الإلكتروني المجهرية على العينات لمعرفة آليات تشوه الزحف. وأوضحت النتائج أن انزلاق حدود الحبيبة هي آلية الزحف ضمن الإجهاد ودرجة الحرارة المعطاة.

الكلمات المفتاح: الزحف ، السبيكة الثلاثية Pb-61.9wt%Sn-2wt%Zn ؛

ميكانيكية الزحف ، إجهاد الشد ، ميكانيكية التشوه ، مدة الزحف .

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The mechanism by which a metal becomes rate-sensitive, depends on grain size. The important role of composition is its effect on grain growth. The greater the volume of second phase, the lower the rate of grain growth because of the relative immobility of interphase boundaries. Grain sizes were measured using a linear intercept technique. The initial grain sizes were $3.25 \pm 0.2 \mu\text{m}$. The smaller grain size reduces the resistance to the transmission of slip across grain boundaries, which can decrease flow stress and increase the ductility of the alloy.

As for the effect of grain size on creep behavior at high temperatures, many researchers found that there is an optimum grain size for maximum creep resistance (lowest steady state creep rate), i.e., the creep rate goes through a minimum as the grain size is varied [17]. Whether this effect is due to grain boundary sliding or not needs to be examined. However, grain boundary sliding is believed to be the rate controlling mechanism of creep in fine grained materials at high temperatures.

4. Conclusions

The main conclusions to be drawn from this work may be summarized as follows:

- (1) The Pb-61.9 wt.% Sn-2 wt.% Zn alloy exhibits the typical creep deformation characteristics. The creep strain increases and creep lifetime decreases with the improved applied stress level and temperature.
- (2) The creep strain rate increases and creep lifetime decreases sharply with increasing applied stress level and temperature.
- (3) The creep deformation of the Pb-61.9 wt.% Sn-2 wt.% Zn alloy is controlled by grain boundary sliding.
- (4) The action of the alloying addition still needs more and more attention.

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place around the columnar grains of the dark phase (Pb-rich phase), thus the number of pinning dislocation points within the grain will decrease and hence the creep rate is

increased. Also Fig. 6 shows the deformation microstructure changes with changing temperature. The main feature of all samples is that (a) the grains have an equiaxed shape, (b) some grains are displaced as a whole above or below the original surface, therefore, a lack of focus is observed, (c) the grains and phase boundaries become wavy and curved, (d) the grains are rotated and their boundaries are distorted[15,16].

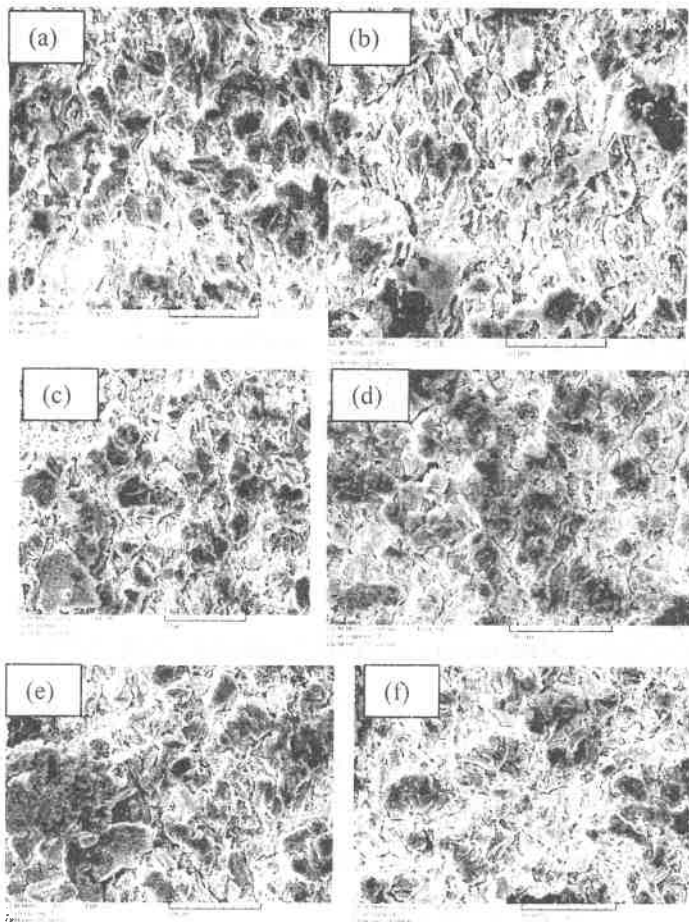


Fig. 6. SEM images of the specimens tested at 7.802MPa under different temperatures :(a) 373; (b) 383; (c)393; (d) 403;(e) 413 and (f) 423 K.

engineering practice. For example, a design engineer can use this diagram as a reference in the selection of studied alloy for high temperature structural applications.

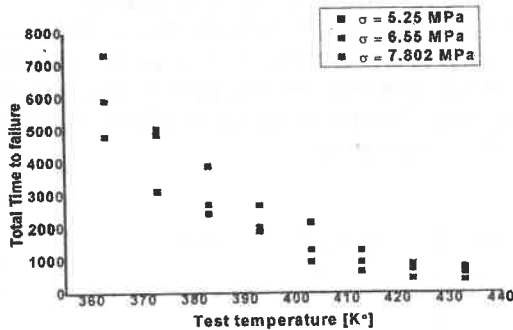


Fig. 4. The creep lifetime as a function of temperature under different stresses.

The variation in flow stress as a function of strain rate for Pb-61.9 wt.% Sn-2 wt.% Zn alloy was plotted in Fig. 5. The flow stress increased with strain rate in a typical sigmoidal curve, at the strain rate ranging from 4×10^{-4} to $1.6 \times 10^{-3} \text{ s}^{-1}$.

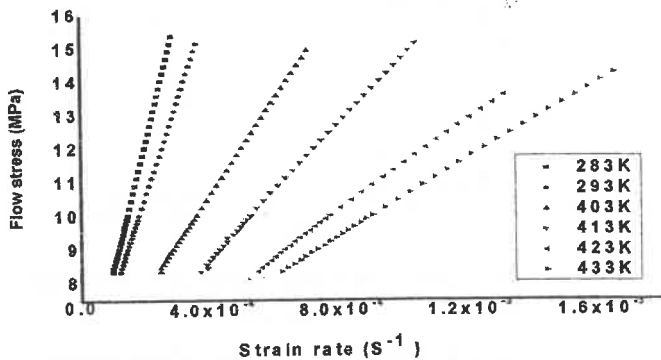


Fig. 5. The variation of flow stress as a function of strain rate in the temperature range between 383 and 433 K for Pb-61.9 wt.% Sn-2 wt.% Zn alloy.

3.2. Microstructure observation.

The microstructure of the specimens crept at various temperatures and applied stresses was observed using a scanning electron microscope (SEM) equipped with energy dispersive X-ray spectroscopy (EDX) analysis.

Fig. 6a-f shows the microstructure investigation for the studied alloy, the samples were crept at various temperatures in the range 373 - 423 K, at a fixed stress of 7.802 MPa. It is clear that the segregation of β -phase (Sn-rich phase) (light) takes

Fig. 3 illustrates the creep behaviour of the Pb-61.9wt%Sn-2wt%Zn alloy at 403K and 423K, where strain is shown as a function of time for samples tested at various stress levels. In all cases, the alloy specimens displayed normal behaviour with respect to the applied stress and temperature, where at any constant temperature the rate of deformation increased with increasing stress and at any constant stress the rate of deformation increased with increasing temperature.

The creep strain increases with an increase in applied stress level and temperature. Then creep strain rate at any given time can be determined by differentiating creep strain versus time and the minimum rate was taken as the creep strain rate of steady-state stage. The total time from the beginning of primary stage to the end of tertiary stage is defined as the "creep lifetime".

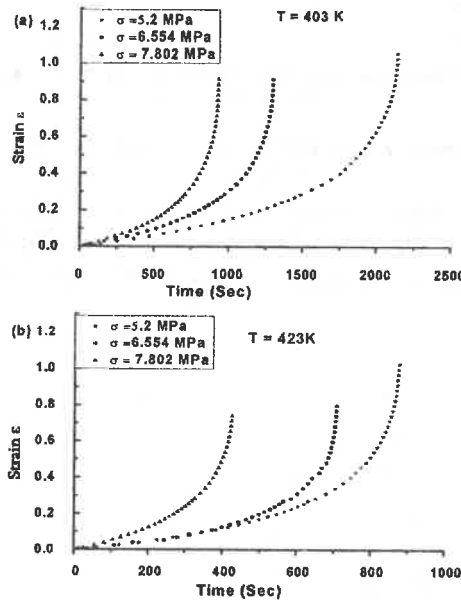


Fig. 3. Typical strain vs. time curves for the Pb-61.9wt%Sn-2wt%Zn alloy at (a)403K and (b)423K under different stresses.

Fig.4 exhibits the temperature dependence of the creep life time of studied alloy, under different stresses, at various temperatures between 363 and 433K. The creep life time was found to decrease with increasing temperature and/or decreasing the applied stress as shown in Fig. 4. As is well known [14], in high temperature engineering design the selection of a material needs to take into account its creep properties. If at a certain temperature this creep lifetime is beyond 1000 sec, the material is normally regarded as a suitable one for applications at that temperature from the standpoint of creep resistance. The diagram in Fig.4 is very useful in

minimum in the creep rate, $\dot{\epsilon}$, followed by a regime with an extended accelerating deformation rate.

At elevated temperatures, most pure metals and commercial alloys display normal creep curves, which are widely assumed to show clearly defined primary, secondary and tertiary stages. This traditional view seems to be fully consistent with the appearance of the curves presented in Fig. 2a, and b, which includes examples of the variations in creep strain ϵ with time for three regions of the Pb-61.9wt%Sn-2wt%Zn alloy, where the primary creep rate decreases with time due to strain hardening of the material. Steady-State creep where the strain increases linearly with time. From design point of view, this region is the most important one for parts designed for long service life because it comprises the longest creep duration. The main creep test result is the slope of this region which is known as the steady-state creep rate. During this stage of creep, there is a balance between strain hardening due to deformation and softening due to recovery processes similar to those occurring during the annealing of metals at elevated temperature, and the tertiary creep rate increases rapidly until failure or rupture. The time to failure is often called the time to rupture or rupture.

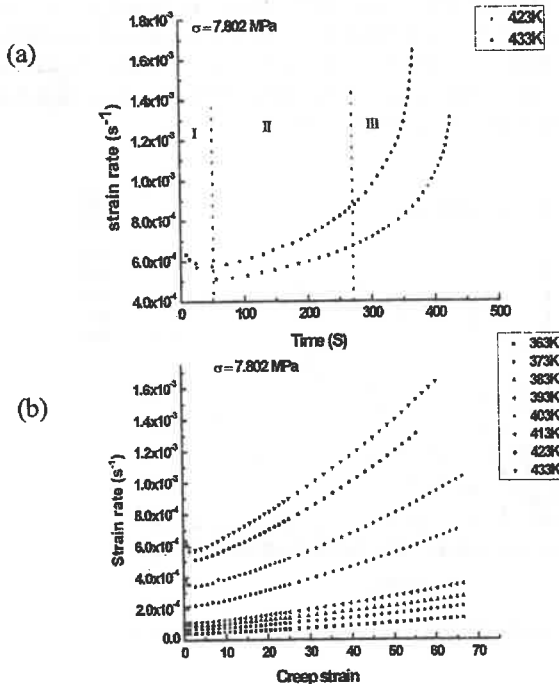


Fig. 2. (a) Creep rate-time curves depicting all the three stages of creep in the temperature 423K and 433K. (b) Creep rate-strain curves in the temperature range between 363 and 433 K for Pb-61.9 wt.% Sn-2 wt.% Zn alloy.

3. Results and discussion

For a certain stress level, the continuous strain created during creep process depends mainly on: (i) grain size of the tested sample, (ii) deformation temperature, and (iii) interaction of dislocations and lattice defects with the solute atoms[12,13].

3.1. Features of creep curves

The creep curves of Pb-61.9wt%Sn-2wt%Zn alloy obtained at different deformation temperatures under different applied stresses for wire samples was obtained as shown in Fig. 1. The samples were investigated in the temperature range 363–433 K in steps of 10 K. As observed, raising deformation temperature affected the creep behavior in Fig. 1 from which the creep strain increased with increasing T while the applied stress is kept constant. The increase in the creep strain by increasing T (Fig. 1) for the alloy under investigation may be due to the decrease in density of the effective pinning centers with increasing T , allowing higher slip distances traveled by the moving dislocations. The trend in the creep curves at all the three levels of applied stresses suggests a rapid transition from a short primary creep regime, to a steady state and tertiary creep regime. This transition is easier to observe in the plot of strain rate versus time that is presented in Fig. 2a and b. It can be seen that each curve is characterized by all the three characteristic regions: (I) primary, (II) secondary or steady state, and (III) tertiary. Since the stress and temperature are constants, the variation in creep rates, $\dot{\epsilon}$, suggests a basic change in the internal structure of the alloy during time.

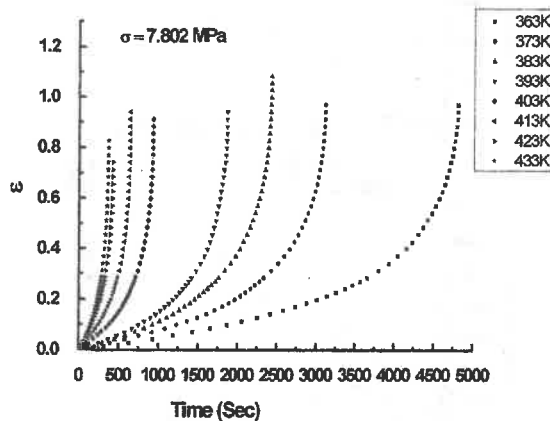


Fig. 1. Representative strain-time curves for Pb-61.9wt%Sn-2wt%Zn samples at different deformation temperatures.

The specific features of the creep for Pb-61.9wt%Sn-2wt%Zn alloy is shown in Fig. 2a, and b, as creep rate-strain curves. Note that all curves showed a distinct

influence on environment and health. On the other hand, the tin-lead solders would no longer satisfy the reliability requirement in high power electronic and optoelectronic components with the smaller size of solder joint and higher mechanical, thermal and electrical load in which the excellent creep resistance is essential[4].

Many Pb-Sn alloys are used in structural applications where creep resistance becomes an important property. One of the obvious ways to improve ductility is by adding alloying elements, and many studies have been performed, resulting in continuous improvement of Pb-Sn alloys. For this purpose, it is necessary to understand how the creep parameters change with alloying additions, repeated thermal cycles and applied stresses, consequently, the future application of these materials strongly depends on the success of improving their reliability with respect to the structural applications [5].

Creep behaviour of materials is generally affected by the applied stress, the deformation temperature, the microstructure of the examined material and also its grain size. Knowledge of the creep behaviour and the effect of second phase on creep deformation is important for understanding and predicting the creep behaviour of solder alloys and for better alloy design[6].

In this study, the tensile creep behavior of Pb-61.9wt%Sn-2wt%Zn solder alloy was investigated at different temperatures and stress levels. The study of creep behaviour for studied alloy samples under different stresses at high temperatures is aimed to identify the microstructure of the tested samples.

2. Experimental materials and procedures

2.1. Sample preparation

The ternary alloy Pb-61.9wt%Sn-2wt%Zn was prepared from high purity Pb, Sn and Zn of purity 99.99%. The appropriate weights of the elements for the ternary alloy were well mixed with CaCl_2 flux to prevent oxidation in a graphite mold. Casting in rod form was performed in a 15 x 1 x 1 cm graphite mold. The casting rod was annealed at 438K for 50 hours. The ingots were rolled into wires of diameter 1mm. Specimens with a gauge length of 50mm were prepared for tensile testing. In this study, the samples were annealed at 443K for 4 h and then slowly cooled to room temperature at cooling rate $T = 2 \times 10^{-2} \text{ K s}^{-1}$. After this heat treatment, the samples were annealed at room temperature for one week before testing. This procedure permitted a small amount of grain growth and grain stabilization to occur [7].

2.2. Mechanical tests

The strain-time experiments were carried out using a conventional type tensile testing machine described elsewhere [8-11]. Isothermal strain-time experiments were performed under constant applied stresses ranging from 5.3 to 7.802 MPa at different deformation temperatures in the range (363-433 K). The elongation in the wire samples was measured by using a dial gauge sensitive to 10^{-5} m . The experimental error was found to be within $\pm 0.5\%$. Environment chamber temperature controlled to $\pm 1\text{K}$ could be monitored by using a thermo-computer in contact with the test sample.

TIME-DEPENDENT DEFORMATION BEHAVIOUR OF TIN-BASED BEARING ALLOY DURING TRANSFORMATION

Alnakhilani Ali (1), Abdulhafiz M(1), Azimah Khalil(2)

(1)Department of Physics-Faculty of Sciences-Damascus University-Syria

(2) Material Sciences Department -Faculty of Mechanical Engineering
And Electrical - Damascus University-Syria.

Abstract

Creep behavior of the Pb-61.9wt%Sn-2wt%Zn ternary alloy has been investigated. Constant tensile stress creep experiments were carried out under constant stresses ranging from 5.3 to 7.802 MPa and at the temperature range from 363 to 433 K. The creep strain rate increases and creep life time decreases as the applied stress level and temperature increase. Scanning electron microscopy analysis was performed on crept as well as uncrept parts of the specimens in order to examine the mechanisms of creep deformation. Grain boundary sliding is the possible creep mechanism within the given stress level and temperature.

Keywords: Creep; Pb-61.9wt%Sn-2wt%Zn ternary alloy; tensile stress; life time; Creep mechanism.

1. Introduction

Creep may be defined as the continuous deformation of a material with time when subjected to a constant stress or load. Its characteristics are known to depend on the applied stress, the temperature, and the microstructure of the sample [1]. Creep plays an important role in metal deformation, whenever the homologous temperature exceeds 0.5T (melting point) as for most solder alloys. The amount and rate of straining during creep are established by the material itself under the imposed stress and temperature conditions [2]. It plays an important role in the mechanical behaviour of materials. Extensive deformation under constant stresses and without risk of fracture has been observed in a wide variety of alloy systems. Some experimental changes in the mechanical properties of materials were observed while undergoing a phase transformation [3].

A typical creep curve for metals can be divided into three stages. The first phase is the primary creep in which the creep rate decreases with time; the second phase is the steady-state creep in which the creep rate remains unchanged, showing a straight line; and the third phase is the accelerating creep in which the creep rate increases quickly over time until failure. For any creep curves, the second phase or the steady-state creep phase is the most important stage to analyze or predict the actual life time of material. In a creep curve, the slope of this stage gives the value of minimum creep rate which can be further used to determine some parameters in power law.

The traditional tin-lead solders have been widely employed as electrical interconnects in electronic industries. However, the toxic Pb can cause harmful

- 3- Denture base reinforced with Co-Cr framework induced the lowest stresses with better distribution.
- 4- High rigid prostheses are recommended because the use of low rigid predicts largest stresses at the implant-bone interface.

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act in a non-perpendicular direction to the occlusal plane thought to disrupt the bone-implant interface (*Isidor, 1996*).

Depending on the magnitude and the direction of the force, force appeared to induce higher stresses at the implant-bone interface areas when PMMA is utilized; i.e. stress transmission is greatest, for MB it is found that the transferring of stresses were the lowest to implant-bone interface. Moreover, RB gained the intermediate state of transmission of the stresses to implant-bone interfaces. This may be attributed to the difference in the elastic moduli of the different patterns of denture base reinforcement. PMMA with the lower elastic modulus which is 2.7 GPa induced highest stresses and concentrate them at the implant-bone interface areas on the loading side than the RB and Mb which have elastic moduli equal to 25.57 and 45.76 GPa respectively.

Benzing et al., (1995)¹⁵ recommended to use high-rigidity prostheses, because the use of low elastic moduli alloys for the superstructure predicts larger stresses at the bone-implant interface on the loading side, than he use of a rigid alloy for a superstructure with the same geometry. Stegariou et al., (1998)¹⁶ used 3-dimensional FEA to assess stress distribution in bone, implant and abutment when gold alloy, porcelain or resin (acrylic or composite) were used for a 3-unit prosthesis. In almost all situations, stress in the bone-implant interface with the resin prosthesis was similar to or higher than that in the models with the other 2 prosthetic materials. Sertgoz, (1997)¹⁷ used three-dimensional finite element analysis to investigate the effect of three different occlusal surface materials (resin, resin composite, and porcelain) and four different framework materials (gold, silver-palladium, cobalt-chromium, titanium alloys) on the stress distribution in a six-implant-supported mandibular fixed prosthesis and surrounding bone. One of the main results of his study was demonstrated that using prosthesis superstructure material with a lower elastic modulus did not lead to substantial differences in stress patterns nor in values at the cortical and spongy bones surrounding the implants. Despite significant differences between the previous studies and the current one (implant-supported mandibular overdenture), the concept of prosthesis materials, their elastic moduli and the mode of stress transferring to the implant supporting bone are approximately common.

Conclusions

A two dimensional finite element model was constructed to compare the stresses transferring to the implant-bone interface by two different patterns of implant supported denture base reinforcement; glass fiber reinforced denture base and Co-Cr framework reinforced denture base as well as unreinforced denture base was utilized. Within the limitations of this study, the following conclusions were drawn:

- 1- Oblique loads induced higher stresses, while vertical loads resulted in better distributed stress.
- 2- The conventional denture base (unreinforced denture base) and the glass fiber reinforced denture base induced the highest stresses at the implant-bone interfaces.

MPa (248.18 microstrain) along the bone side of the implant-bone interface area 1 and 0.877 MPa along the implant side of the implant-bone interface are 1. According to Frost, (1987)¹¹ who proposed that bone responds to a complex interaction of strain magnitude and time. As bone strains are typically very small, it is common to use the term μ strain (microstrain). Conceptually, the interfacial bone maturation, crestal bone loss and loading can be explained by the Frost mechanostat theory, which connects the two processes of modeling (new bone formation) and remodeling (continuous turnover of older bone without a net change in shape or size). In accordance with the theory, bone acts like a 'mechanostat', in that it brings about a biomechanical adaptation, corresponding to the external loading condition. Frost described four microstrain zones and related each zone to a mechanical adaptation. The four zones include the disuse atrophy, steady state, physiologic overload and pathologic overload zones. Both extreme zones (pathologic overload zone and disuse atrophy zone) are proposed to resolve in decrease in bone volume. When peak strain magnitude falls below 50-200 μ strain, disuse atrophy is proposed to occur, a phenomenon that is likely to explain ridge resorption after tooth loss. In the pathologic overload zone, peak strain magnitude of over 4000 strain may result in net bone resorption. The steady state one comprises the range between disuse atrophy and physiologic overload zone, and is associated with organized, highly mineralized lamellar bone. The strain magnitude of 100-2000 μ strain is thought to elicit this favorable bone reaction. The physiologic bone overload zone covers the range between 2000 and 4000 μ strain, and is suggested to result in increase in bone mass. The new bone formed is woven bone (immature bone) that is less mineralized, less organized and consequently weaker than the lamellar bone. It is probable that bone mass will increase, until the bone interface accommodates this change, and the load strain values that falls back into the range of steady state zone.

Haraldson and Carlsson(1977)¹² measured 15.7 N for gentle biting, 50.1N for biting as when chewing, and 144.4N for maximal biting for 19 patients who had been treated with implants for 3.5 years. In another study, Carr and Laney, (1987)¹³ reported maximal bite forces between 4.5 and 25.3 N before and 10.2-57.5 N after 3 months of treatment with implant-supported prosthesis, and emphasized that the amount of increase was dependent on the duration of being edentulous.

If an average of 30 N force is applied axially, the maximum strain magnitudes in the peri-implant bone are 4270 μ strain with PMMA, which is located within the pathologic overload zone, 3941 μ strain (proximate to the borderline of the pathologic overload zone) for RB and 3285 μ strain for MB which is located within the physiologic overload zone. Above the magnitude of 36 N in the axial direction, the peri-implant supporting bone of the various patterns of denture base reinforcement is located within the pathologic overload zone. While, if an oblique (non-axial) force of 20N or more is exerted, the peri-implant supporting bone of the various pattern of denture base reinforcement is located within the pathologic overload zone.

Occlusal loads, in general are classified as axial and non-axial forces. Axial forces act perpendicular to the occlusal plane and are suggested to be more favorable as they distribute stress more evenly throughout an implant, while non-axial forces

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accepted theoretical technique used in the solution of engineering problems. In implant dentistry, finite element analysis has become an increasingly useful tool for the prediction of the effect of the internal generated stresses and the distribution of these stresses in the contact areas of the implants with surrounding bone. FEM has other advantages, including accurate representation of complex geometries and easy model modification. FEM is a mathematical model of a real object and it is usually impossible to reproduce the entire details of natural behavior. Thus, an experimental or clinical study cannot be completely replaced by a numerical test. Several assumptions were made in the development of the model in the present study. The structures in the model were all assumed to be homogeneous and isotropic and to possess linear elasticity (Yokoyama et al., 2004)⁹. The properties of the material modeled, particularly the living tissues (cancellous bone), however are different. For instance, it is well documented that the bone is homogeneous and anisotropic. All interfaces between the materials were assumed to be bonded or completely osseointegrated, which is not 100% found naturally. In addition, the modeled section of the mandible was composed entirely of cancellous bone. Therefore, inherent limitations of FEM must be acknowledged.

When applying FE analysis to dental implants, it is important to consider, not only, axial loads and horizontal forces (moment-causing loads), but also a combined load (oblique occlusal forces) because the latter represents more realistic occlusal directions and, for a given force, will result in localized stress in the surrounding bone. Naturally, in-vivo, the occlusal forces exerted on the abutment (tooth or implant) vary in direction and magnitude; the largest forces occur along the axial direction, while the lateral component of the occlusal force is significantly smaller (Brunski, 1997)¹⁰. Oblique of 45 degree to the vertical axis of the supporting implant loads were considered. The results obtained from the analyses when IN load was exerted to the models are compared as follows:

The induced von Mises stresses in the MB and its rider component the highest, followed by RB and PMMA with their riders respectively. The opposite was for the sleeves: the highest induced stresses were accompanied with PMMA followed by RB and MB respectively.

For the superstructure bar, implant abutments and the surrounding cancellous bone, the induced von Mises stresses were the highest when postulated PMMA, and the lowest with MB. The situation was completely different with the fixation screws and the implant fixtures, the highest stresses were registered when the RB was postulated, and the lowest stresses occurred with MB.

Regarding the implant-bone interface areas (area1-area4), the induced von Mises stresses were the highest (in a similar aspect to the axial load) when loading the unreinforced denture base (PMMA) (the maximum values were 0.379 MPa (276.64 microstrain) along the bone side of the implant-bone interface area1 and 1.48 MPa along the implant side of the implant-bone interface area 2). Followed by the glass fiber reinforced denture base (RB) (the maximum values were 0.366 MPa (267.15 microstrain) along the bone side of of the implant-bone interface area 2 the lowest stresses were generated in the implant-bone interface areas when using Co-Cr framework reinforced denture base (MB) the maximum values were 0.340

$$= (0.33 \times 72) + [(0.67) \times 2.7]$$

$$= 25.57 \text{ GPa}$$

2. Poisson's ratio:

$$V = (v_1 v_1) = (1 - v_1) v_2$$

$$= (0.2 \times 0.33) + (0.8 \times 0.35) = 0.346$$

Boundary conditions:

The boundary conditions in finite element models basically represent the loads imposed on the structures under study and their fixation counterparts, the restraints. In addition, they may involve interaction of groups of interconnected finite elements (constraints) or physically separated bodies (contact).

Constraints on nodal displacements were fed as input data to prevent movement of some nodal points along a specific direction according to the physical nature of the deformation taking place in the assembly with the different denture base patterns. The supporting alveolar bone was fixed along its boundaries as well. The finite element mesh model was loaded with 1 Newton (N) load in two directions; axial (vertical) direction along the long axis of the supporting implants and non-axial direction (oblique load of 45 degrees to the vertical axis of the supporting implants distomedially). The different patterns of denture base were interchanging for each load by applying the elastic properties for each one as input data.

Results

Regarding the dental implants; the stress contours with maximum von Mises stresses values of 0.680 MPa when conventional (unreinforced) denture base (PMMA) was utilized, 0.734 MPa with glass fiber reinforced denture base (RB) and 0.677 MPa for metallic reinforced denture base (MB). For the surrounding cancellous bone the maximum von Mises stresses were concentrated more around the necks (crestal bone) of the dental implants with the values of 0.252 MPa for PMMA, 0.244 MPa for RB and 0.227 MPa for MB.

Discussion

The use of implants to provide support for overdentures is an attractive treatment because it improves retention, stability, function and comfort of the prosthesis. Due to the relatively large space needed in the denture base to occupy the implants, abutments and attachment, the result is either a denture that is thinner than normal and therefore susceptible to fracture or an overbulked denture that may interfere with the tongue and speech; both are unfavorable situations for the patient. Therefore, reinforcement of the denture base with metallic or fiber reinforced composite frameworks may solve those problems without increasing the thickness of the denture base. However, the effect of this framework reinforcement on the stress distribution around the implants has not been clarified. This study aimed to investigate, analyze and compare the stresses around the implants supporting overdentures, when reinforced with metallic and glass reinforced frameworks. This study used two dimensional finite element methods (2D FEM) to investigate the stresses around implants supporting overdenture. The finite element method (FEM) is one of the most frequently used methods in stress analysis in dentistry. It is an

- Bar connector and fixation screws.

Connector: Length= 3 mm. Diameter = 3.4 mm. Screw: Length= 5 mm. Diameter=1.25 mm.

- Metallic sleeve and rubber rider.

Width= 5 mm. Diameter= 3 mm.

- PMMA denture base.

Thickness= 2 mm. Width= 45 mm.

The denture base is postulated in a there separated different patterns of reinforcement which are:

1. Conventional (unreinforced) denture base utilized as control .
2. Reinforced with glass fiber reinforced composite (RB).
3. Reinforced with Cobalt chromium (Co-Cr) alloy framework (MB).

Finite element mesh:

The model was meshed using 2D plane stress element type, with quadrilateral shape, 0.2 mm size and 8 nodes for each element. The total element number is 7411, and the total nodal number is 22791.

Materials properties:

Finite element models, however, assume that materials are idealized as homogeneous and generally isotropic, linearly elastic and to be rigidly bounded together with continual interfaces between them. The elastic properties of the materials used to build up the model are as the follows:

1. Cancellous bone : Young's modulus : 1.37 sGPa, Poisson's ratio: 0.31 (Borchers and Reichart,1983)³
2. Cobalt chromium alloy : Young's modulus: 218 Gpa, poisson's ratio: 0.33(Craig, 1989)⁴
3. Titanium: Young's modulus: 115 GPa, Poisson's ratio: 0.35 (Meijer et al., 1993)⁵
4. Rubber rider; Young's modulus: 0.005 GPa, Poisson's ratio: 0.45 (Tillitson et al., 1971)⁶
5. PMMA denture base: Young's modulus: 2.7GPa, Poisson's ratio:0.35 (Craig, 1989)⁴
6. Glass FRC: Young's modulus: 72GPa, Poisson's ratio: 0.2 (Freilich et al., 2000)⁷

Vallittu (1996)⁸ stated that the highest transverse strength with PMMA-based fiber composite was obtained by incorporating 58% weight (33% volume) glass fiber into PMMA resin. So, the Young's modulus and Poisson's ratio of the denture base reinforced with glass fiber reinforced composite (RB) are calculated by the equations:

1. Young's modulus:

$$E = (v_1 E_1) + (1 - v_1) E_2$$

Freilich et al, (2002)² stated that when FRC materials are compared to metal alloys, the toxicity and corrosion that plague metal and metal ions in the oral environment are not a concern with composite materials, and FRC substructures are less rigid than conventional metal substructures. Decreased rigidity may result in fewer fractures of an opposing complete denture and a difference in the strain placed on the dental implant-bone interface.

A key factor for the success or failure of a dental implant is the manner in which stresses are transferred to the surrounding bone. Finite element analysis method allows predicting stress distribution in the contact area of the implants with cortical bone and around the apices of the implants in the trabecular bone.

The aim of this study was finite element stress analysis of fiber reinforced composite versus metallic frameworks for implant supported mandibular overdenture. The stresses were analyzed under non-axial loads (lateral in distomesial direction at 45 degree to the long axes of the supporting implants) in the implant-bone interface.

Materials and Methods

Finite Element Analysis

The two dimensionally plane strain finite element method (2D-FEM) was selected to perform the stress analysis of this considered work. This method is particularly suitable for biological structure analysis as it allows great flexibility in dealing with geometric complex domains composed by multiple materials. In this study ANSYS software package was utilized.

Geometrical details:

The geometrical of the standard midlabiolingual section in the human interforaminal region of the mandible in the coronal plane with two osseointegrated root from implants, abutments, bar type superstructure with its clip and the implant supported overdenture PMMA denture base are illustrated as follows:

- Mandibular midlabiolingual section .

Length= 21 mm. With= 42 mm. The bony section represents cancellous bone.

- Implant fixture dimensions.

Length = 15 mm. Diameter= 3.4 mm. Number of threads=15.

Distance between the two implants=26 mm.

The implant on the left side of the model is referred to as implant 1, and the other one on the right side is referred to as implant2. Moreover implant-bone interface left to the implant 1 is assigned as area 1, Area 2 is denoting the interface between the right side of implant left 1 and the cancellous bone. The implant-bone interface left to implant 2 is area 3 and area 4 is the interface right to the implant 2.

- Implant abutments.

Length =3 mm. Diameter=3.4 mm.

- Abutment's screw.

Length =5 mm. Diameter=1.25 mm.

- Bar attachment (substructure).

Thickness= 2 mm. Inverted pear in cross section, the upper dimension = 2.5 mm and the lower =1.5 mm. width=45 mm.

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Yasser Thabet. P.hD, Ibb university –collage dentistry,
Anees Murshed. B.D.S,

Abstract This study was undertaken to analyze and compare the induced stresses at the osseointegrated implants, superstructures, prosthesis and the implant-bone interface area when utilizing two patterns of denture base reinforcement for implant supported mandibular overdenture; the glass fiber reinforced composite and the metallic frameworks. Two dimensional finite element method were implemented to build up the mesh model with element number = 7411 and total nodal number =22791.1 Newton load was exerted to the assembly in the axial direction to the long axes of the supporting implants and in the lateral (oblique) distomesially direction of 45 degree to the long axes of the supporting implants. It was found that the glass fiber reinforced denture base induced highest stresses at the implant –prosthesis complex, as well as at the implant-bone interface area with strain values near the borderline of the pathologic overload zone of the bone more than the metallic reinforced denture base. It was concluded that this may be attributed to the difference in the elastic moduli of the different patterns of denture base reinforcement and that the high rigid prostheses are recommended because the use of low rigid predicts the largest stresses at the implant-bone interface. The elastic moduli are 25.27 GPa for the glass fiber reinforced and 45.76 GPa for the metallic reinforced denture base.

Introduction

Implant overdentures are now accepted as a treatment alternative for many edentulous patients. Regardless of the technique used, the implants and attachments occupy space that would otherwise be filled with denture resin in the conventional denture. The result is either a denture that is thinner than normal, and therefore susceptible to fracture, or a bulky denture that may interfere with the tongue and speech.

To avoid either unfavorable situation, a metal framework is often made to provide rigidity and reinforcement to the acrylic resin overdenture, while allowing for natural contours of the denture resin. This metal framework is expensive, time-consuming to fabricate, unaesthetic and the metal alloys used pose potential toxicity problems during fabrication or after delivery.

Duncan et al, (2000)¹ described a method to fabricate a framework for an implant-supported overdenture using unidirectional glass fiber-reinforced composite (FRC) that replaces the standard Nickle chromium (Ni-Cr) or Cobalt chromium (Co-Cr) alloys frameworks. The authors stated that the advantages of a FRC framework make it a realistic option for replacement of a metal framework. A FRC framework has the potential to provide the same benefits as a metal framework in a more efficient manner.

تحديد مستويات اليوريا والكرياتينين والإنزيمات القلبية قبل وبعد الديال الدموي (الغسيل الكلوي).

محمد علي الدعيس* ويحكر محمد البو*

قسم الكيمياء - كلية العلوم - جامعة أب - اليمن.

قسم الكيمياء الحيوية - كلية العلوم الطبية - جامعة الحدود الشمالية - السعودية.

الملخص

تشكل امراض الكلية المزمنة مشكلة صحية عالمية وهناك علاقة بينة وثيقة بين الكلية والقلب . هدفت هذه الدراسة الى تحديد مستويات اليوريا والكرياتين والانزيمات القلبية عند المرضى اليمنيين الذين يخضعون لعملية الغسيل الكلوي قبل وبعد الغسيل.

اجريت هذه الدراسة على عدد 50 مريضاً يمنياً مصابون بالفشل الكلوي المزمن ويخضعون لعملية الغسيل الكلوي لفترة تزيد عن ستة أشهر في وحدة غسيل الكلى في مستشفى الثورة العام بمدينة أب. تم اخذ عينات الدم غير الصيامي من كل المرضى مباشرة قبل الغسيل وبعد الغسيل مباشرة في نفس اليوم ومن ثم قياس مستويات كلا من اليوريا والكرياتينين والانزيمات القلبية (كرياتين كيناز واسبارتات امينوترانسفيراز ولاكتات ديهيدروجيناز) . كان متوسط تركيز اليوريا قبل الغسيل وبعده 8.7 ± 20.9 و 6.4 ± 10.2 ملمول/لتر على التوالي. كان متوسط تركيز الكرياتينين قبل وبعد الغسيل مباشرة 110 ± 884 و 324 ± 96 ميكرومول / لتر على التوالي . انخفضت مستويات اليوريا والكرياتينين بحوالي 51% و 63% على التوالي وكان هذا الانخفاض معنوياً ($P < 0.05$) . ارتفعت مستويات كلا من اسبارتات امينوترانسفيراز (AST) وكرياتين كيناز (CK) ولاكتات ديهيدروجيناز (LDH) بعد الغسيل بحوالي 121% و 89% 39% على التوالي وكان هذا الارتفاع غير دال إحصائياً ($P > 0.05$) . هذه النتائج تظهر انه تم إزالة اليوريا والكرياتينين بشكل كبير بعد الغسيل الكلوي. هذه النتائج تؤكد كذلك أن ارتفاع مستويات الإنزيمات القلبية في المصل يتناسب مع وجود خلل و/ أو إصابة في عضلة القلب. علاوة على ذلك فان كل الإنزيمات القلبية المذكورة أعلاه لا تعتبر تخصصية فقط لإصابة عضلة القلب. يرى الباحثان عدم كفاية استخدام الإنزيمات القلبية لوحدها كمؤشر فعال لتقييم وجود إصابة و/أو مدى هذه الإصابة عند مرضى الفشل الكلوي .

كلمات مفتاحية : يوريا ، كرياتينين ، الإنزيمات القلبية ، الديال الدموي.

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Isoenzymes are more specific indicators of cardiac muscle damage and are increasingly used in the investigation of cardiac damage (Gaw, *et al*, 2004). These results are in agreement with a previous study which stated that with repeated dialysis coronary heart disease (CHD) may get progressively worse and further accentuate coronary heart disease (Al-Rashidi, *et al*, 2004). In conclusion, post-dialysis urea and creatinine were reduced by hemodialysis, while AST, CK and LDH were increased after hemodialysis.

DETERMINATION OF UREA, CREATININE AND CARDIAC ENZYMES LEVELS BEFORE AND AFTER HEMODIALYSIS

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purchased from Spinreact Company (Spain) and Spectrophotometer made by Spectronic Company (USA) was used for analysis.

Data was reported as means \pm SD. P- value less than 0.05 was considered statistically significant. Pre- and post-dialysis levels of the different analytics were compared for the subjects, using student's t tests. The statistical software used for analysis was SPSS, Version 10.0.

RESULTS AND DISCUSSION

Levels of urea, creatinine, AST, CK, and LDH in the study group (means \pm SD)

Analyte	(normal range *)	Pre- dialysis	Post- dialysis	P value
Urea	(2.5- 8 mmol / L)	20.9 \pm 8.7	10.2 \pm 6.4	<0.05
Creatinine	(40- 130 μ mol/L)	884 \pm 150	324 \pm 96	<0.05
AST	(12- 48 U/L)	63.3 \pm 29.6	139.8 \pm 114.1	> 0.05
CK	(<150 U/L)	183.2 \pm 84.5	346.5 \pm 328.6	> 0.05
LDH	(230- 525 U/L)	247.9 \pm 75	344.5 \pm 174.1	> 0.05

* Gaw *et al.*, 2004

Table indicates the pre- and post-dialysis levels of urea, creatinine and cardiac enzymes in the study group. The mean urea pre- and immediately post-dialysis was 20.9 \pm 8.7 and 10.2 \pm 6.4 mmol/L, respectively. These results confirm that post-dialysis urea is clinically important phenomenon and should be considered in the evaluation of dialysis efficiency and clearance. Furthermore, immediate post dialysis urea does not, in fact, reflect the actual concentration of urea in the body and may overestimate dialysis efficiency and clearance. The mean creatinine pre- and immediately post-dialysis was 884 \pm 110 and 324 \pm 96 μ mol/L, respectively. The increasing of pre- dialysis creatinine approximately seven times greater than normal value confirms that serum creatinine is a better indicator of renal function than either that of urea or that of uric acid because serum creatinine is not affected by diet, exercise or hormones, factors that influence the levels of urea or uric acid (Perrone, *et al.*, 1992; Marshal, and Bangert, 2008). Levels of urea and creatinine fell significantly respectively by about 51% for urea and 63% for creatinine. Our results confirm that urea and creatinine, as metabolic toxic waste products in the blood were removed by hemodialysis which is the main goal of the dialysis (Foley, *et al.*, 1998). These results also show that our dialysis machines were functioning properly. Furthermore, these findings are in accordance with a previous study (Al- Wakeel, 1998).

There have been no published data to confirm pre- and post dialysis levels of cardiac enzymes. Pre- dialysis levels of AST, CK and LDH were 63.3 \pm 29.6, 183.2 \pm 84.5 and 247.9 \pm 75 U/L respectively; while post dialysis levels were 139.8 \pm 76.1, 346.5 \pm 168.6 and 344.5 \pm 174.1 U/L respectively. Levels of AST, CK and LDH were increased non significantly by about 121%, 89% and 39% respectively. It should be noted that increases in serum cardiac enzyme activity is only roughly proportional to the extent of tissue damage (Gaw, *et al.*, 2004). Furthermore all above enzymes are not specific only for cardiac muscle damage. Moreover CK and LDH have isoenzymes (enzymes are present in the plasma in two or more molecular forms).

INTRODUCTION

Chronic kidney disease (CKD) has been described as a global health concern (Tonelli *et al*, 2006 ; Zhang and Rothenbacher , 2008).A complex inter-relationship exists between the kidney and the heart (Ilion , and Fumeron , 2005).Cardiovascular morbidity and mortality is increased in patients who reach end-stage renal disease(ESRD) (Foley *et al* , 1998 ; Sarnak ,2003) as well as in milder degrees of renal dysfunction(Foley , *et al* 2005., Go , *et al* 2004 ; Vanholder *et al* 2005). Urea is the major disposal form of amino groups derived from amino acids, and accounts for about ninety percent of the nitrogen-containing compounds of urine (Champe *et al*, 2008; Stiller *et al*, 2001). The prime aim of chronic dialysis is to remove the nitrogenous metabolic end-products and excess fluid (Foley *et al*, 1998). During hemodialysis reduction in the urea concentration in the intracellular fluid (ICF) compartment will lag behind that in the extra cellular fluid (ECF) compartment, and following the end of dialysis (Al- Wakeel , 1998). Creatine and creatine phosphate spontaneously cyclize at a slow but constant rate to form creatinine, which is excreted in the urine. The amount of creatinine excreted is proportional to the total creatine phosphate content of the body, and thus can be used to estimate muscle mass (Champe *et al*, 2008).In addition, any rise in blood creatinine is a sensitive indicator of kidney malfunction, because creatinine normally is rapidly removed from the blood and excreted (Champe *et al*, 2008; Marshal and Bangert, 2008). Small amounts of intracellular enzymes are present in the blood as a result of normal cell turnover. When damage to cells occurs, increased amounts of enzymes will be released and their concentrations in the blood will rise. Historically, the cardiac enzymes commonly used to diagnose myocardial infarction (MI) included creatine kinase (CK), aspartate aminotransferase (AST) and lactate dehydrogenase (LDH) (Gaw *et al*, 2004; McDonnell , *et al*, 2009).This study was aimed to determine the pre- and post- dialysis levels of urea, creatinine and cardiac enzymes among Yemeni patients undergoing intermittent maintenance hemodialysis in Ibb city, Yemen.

PATIENTS AND METHODS

Fifty Yemeni subjects, aged 18-65 years, diagnosed with chronic renal failure (CRF) and undergoing intermittent maintenance hemodialysis (MHD) for at least six months at the Dialysis Unit of Al-Thawra hospital in Ibb city, were enrolled in this study, during the period from 1st February to 30th of June 2009. The subjects were on twice per week, 3-hourly haemodialysis sessions, typically in the morning or afternoon and were none fasting. They were interviewed for details of their age, sex, smoking habit, qat chewing, current medications and history of diabetes, coronary heart disease (CHD), and hyperlipidemia. Dialysis in each subject was on changed poly sulfone dialyser on a fresenius 4800S Haemodialysis machine (Fresenius, Germany) and bicarbonate dialysate (Fresenius, Germany). Non- fasting blood samples were collected from each subject immediately prior to dialysis (pre-dialysis), and immediately on completion (post-dialysis) of the dialysis session on the same day. Serum has been obtained, separated and studied .The pre-and post-dialysis samples were analyzed for serum urea, creatinine, creatine kinase (CK), aspartate aminotransferase (AST) and lactate dehydrogenase (LDH). Reagents were

DETERMINATION OF UREA, CREATININE AND CARDIAC ENZYMES LEVELS BEFORE AND AFTER HEMODIALYSIS.

Mohamed .A.Al-Duais and Baker .M.Al-Bow

Department of Chemistry, Faculty of Science, Ibb University, Yemen.

Department of Biochemistry, Faculty of Medical Sciences, Northern Border University, Saudi Arabia.

Corresponding Author. E-mail: mahaldouis@yahoo.com

ABSTRACT.

Chronic kidney disease (CKD) has been described as a global health concern. A complex inter-relationship exists between the kidney and the heart. This study was aimed to determine the pre- and post- dialysis levels of urea, creatinine and cardiac enzymes among Yemeni patients undergoing intermittent maintenance hemodialysis.

Fifty Yemeni subjects, aged 18-65 years, diagnosed with chronic renal failure (CRF) and undergoing intermittent maintenance hemodialysis (MHD) for at least six months at the Dialysis Unit of Al-Thawra hospital in Ibb city were enrolled in this study. Non – fasting blood samples were collected and analyzed for serum urea , creatinine , creatine kinase (CK) , aspartate aminotransferase (AST) and lactate dehydrogenase (LDH). The mean urea pre- and immediately post-dialysis was 20.9 ± 8.7 and 10.2 ± 6.4 mmol/L, respectively. The mean creatinine pre- and immediately post dialysis was 884 ± 110 and 324 ± 96 μ mol/L, respectively.

Levels of urea and creatinine were decreased significantly ($P < 0.05$) by about 51% and 63% respectively. Levels of AST, CK and LDH were increased non significantly ($P > 0.05$) by about 121%, 89% and 39% respectively. These results show that urea and creatinine were removed by hemodialysis. These results also confirm increased levels of serum cardiac enzymes, which are only roughly proportional to the extent of tissue disorder and / or tissue damage. Furthermore all above enzymes are not specific indicators for only cardiac muscle damage. Researchers suggested that, the use of cardiac enzymes only as indicators for the extent of cardiac disorder and / or cardiac tissue damage in hemodialysis patients is inadequate.

Key words: Urea, Creatinine, Cardiac Enzymes, Hemodialysis.

Dear Mr. [Name],

I have received your letter of the 15th and am pleased to hear that you are interested in the [Project Name].

The [Project Name] is a very important project and we are looking for people who are interested in it.

I would like to see you at the [Location] on [Date] to discuss the project in more detail.

I am sure that you will find this project very interesting and I hope to hear from you again soon.

Yours faithfully,

[Signature]

[Address]

(English Section)

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The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry should be supported by a valid receipt or invoice. This ensures transparency and allows for easy verification of the data. The second part of the document provides a detailed breakdown of the financial data, including a list of all accounts and their respective balances. It also includes a summary of the total assets and liabilities, which shows that the organization is in a financially sound position. The final part of the document concludes with a statement of the auditor's findings and a recommendation for further action.

The auditor has reviewed the financial statements and found them to be accurate and complete. There were no significant discrepancies or irregularities identified during the audit. The management of the organization is commended for their diligent record-keeping and adherence to accounting principles. It is recommended that the organization continue to maintain high standards of financial reporting and transparency.

The following table provides a summary of the key financial metrics for the period under review. The data shows a steady increase in revenue and a corresponding decrease in expenses, resulting in a positive net income. The organization's financial health is strong, and it is well-positioned to meet its long-term goals.

In conclusion, the financial statements for the period are accurate and reliable. The organization's financial performance is strong, and it is recommended that the management continue to focus on maintaining high standards of financial reporting and transparency. The auditor's findings are positive, and there are no significant concerns identified.

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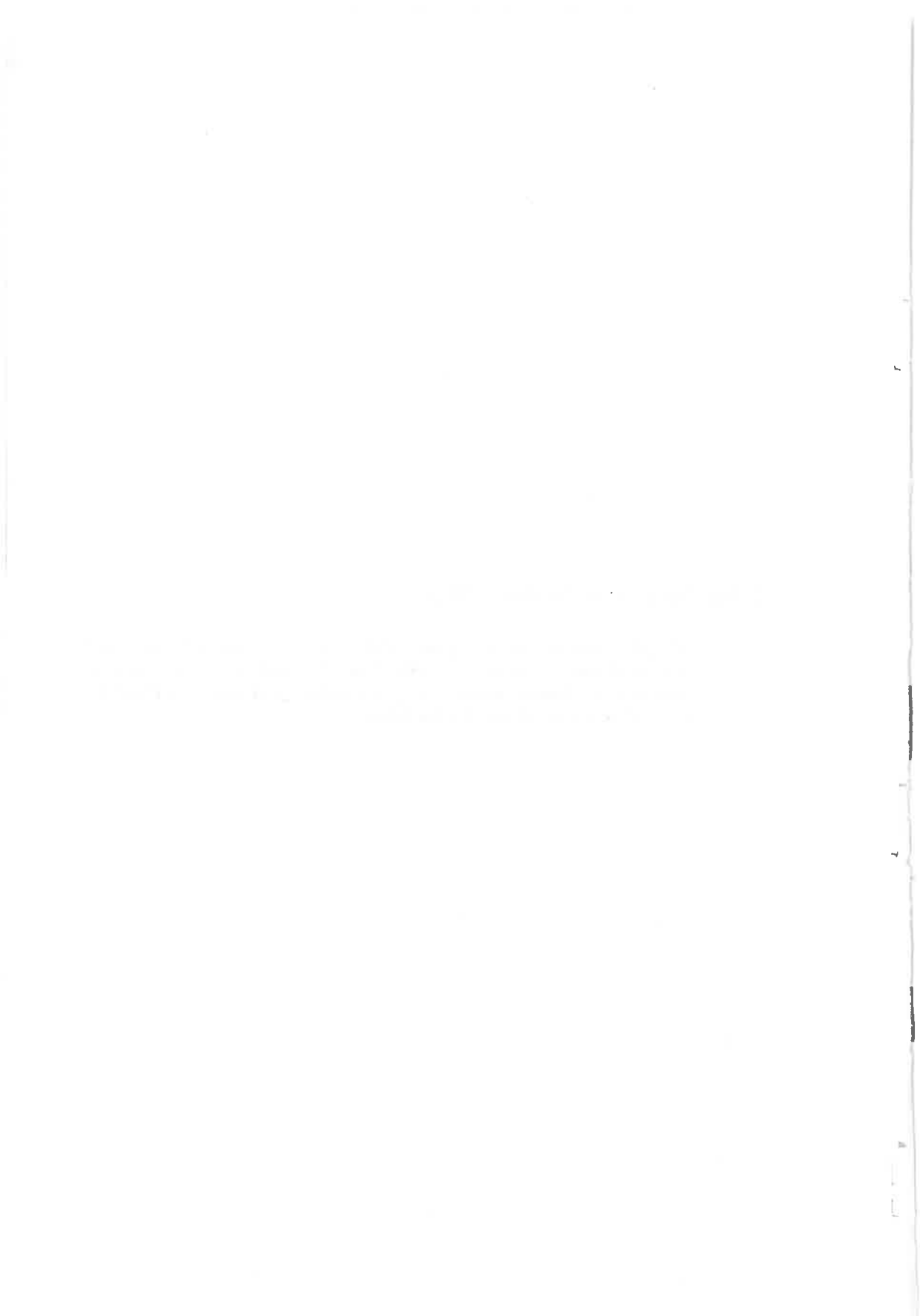
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