INTRODUCTION

Glucosamine sulfate is a widely used oral supplement which has shown disease modifying potential in the treatment of osteoarthritis in both human and animal studies\(^1,2\). Systemic bioavailability of ingested glucosamine has previously been illustrated in serum and synovial fluid\(^3,4\). In vitro studies suggest glucosamine may also augment degenerative disc disease by stimulating proteoglycan synthesis and decreasing inflammation\(^5,6,7\). Additionally in vivo studies in which glucosamine was administered orally have shown disease modifying potential in improving patients symptoms\(^8\). Despite the potential benefits of glucosamine supplementation, bioavailability in disc tissue following oral administration has not been shown in vivo. Thus the objective of this study was to examine glucosamine sulfate concentrations in the Nucleus Pulposus of New Zealand white rabbits following oral administration for 30 days in comparison to controls.

METHODS

Prior to the initiation of this project it was approved by the IACUC at our home institution. A total of six skeletally mature female New Zealand White rabbits were included in this study. All rabbits were approximately 5kg upon purchase. The glucosamine sulfate was purchased and separately analyzed for purity, associated salt and heavy metal toxicity by a private laboratory (BioQuant Inc, San Diego, CA). Three rabbits were fed 85mg of glucosamine sulfate daily for 30 days, while the other three controls received no glucosamine supplementation. The dose of 85mg daily was based on the daily recommendation of glucosamine\(^9\). After thirty days the lumbar intervertebral discs were harvested and the Nucleus Pulposus tissue isolated and consolidated for analysis. Glucosamine content within the Nucleus Pulposus tissues was determined via the High Performance Liquid Chromatography (HPLC) method.

RESULTS

The glucosamine sulfate used in this study was 98% pure, met specification for yeast and mold (<10 sfu/g), was negative for E. coli or salmonella contamination, and heavy metals toxicity (<10 ppm). Rabbits 1055, 56 and 57 were in the treatment group, while 58, 59 and 60 served as controls. The harvested NP tissue was weighted prior to analysis with the mean being 2.26 μg/g in the treatment group, compared to 0.052 μg/g in the control group. This finding was statistically significant (p=0.043). This data is summarized in table 1.

DISCUSSION

Glucosamine sulfate concentrations were significantly higher in the nucleus pulposus of rabbits who received the supplement orally in comparison to controls. This suggests that orally consumed glucosamine sulfate does enter the nucleus pulposus of intervertebral discs in significant concentrations. This finding will facilitate the development of in vivo studies to assess the effect of this compound on degenerative disc disease.

ACKNOWLEDGEMENTS

This study was supported by NIH/NCCAM grant K08AT004718-01A1 to G.S. This study was also supported in part by The Albert B. Ferguson, Jr. MD Orthopaedic Fund of The Pittsburgh Foundation. We would like to thank the DLAR staff at the University of Pittsburgh and BioQuant Inc. (San Diego, CA) for assistance in completing this project.

**TABLE 1**

<table>
<thead>
<tr>
<th>Rabbit ID</th>
<th>Nucleus Pulposus (g)</th>
<th>Total Amount (μg)</th>
<th>Concen. (μg/g)</th>
<th>Mean Conc (μg/g)</th>
<th>P Value (t test)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1055</td>
<td>0.116</td>
<td>0.438</td>
<td>3.773</td>
<td>-</td>
<td>0.043</td>
</tr>
<tr>
<td>1056</td>
<td>0.134</td>
<td>0.207</td>
<td>1.544</td>
<td>0.260</td>
<td></td>
</tr>
<tr>
<td>1057</td>
<td>0.220</td>
<td>0.322</td>
<td>1.463</td>
<td>0.053</td>
<td></td>
</tr>
<tr>
<td>1058</td>
<td>0.163</td>
<td>0.009</td>
<td>0.053</td>
<td>0.052</td>
<td></td>
</tr>
<tr>
<td>1059</td>
<td>0.107</td>
<td>0.007</td>
<td>0.069</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1060</td>
<td>0.201</td>
<td>0.007</td>
<td>0.034</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Green highlight denotes the treatment group. The mean glucosamine concentration was significantly higher for the treatment group in comparison with the controls.

REFERENCES