Soccer players often experience eccentric exercise-induced muscle damage. An improved muscle function recovery from eccentric exercise has been shown with protein feeding. Since fish oil derived n-3 polyunsaturated fatty acids (n-3PUFA) exhibit anti-inflammatory properties, combining fish oil with protein may facilitate recovery. PURPOSE: To assess the influence of 6 wk supplementation with a juice-based antioxidant-containing drink containing a combination of n-3PUFA, whey protein and vitamin D on muscle function and soreness and soccer performance during exercise recovery. METHODS: Soccer players (n=30) were assigned to one of three conditions. The experimental condition (FO) contained n-3PUFA (500 mg DHA, 550 mg EPA), whey protein (15 g), carbohydrate (14 g) and vitamin D (3 μg). The control condition (CHO) contained carbohydrate. Eccentric exercise consisted of 12 sets unilateral knee extension/flexion contractions on both legs separately. Statistical analyses included conventional p-value and magnitude-based inferential approaches. RESULTS: FO suggests the incorporation of n-3PUFA into the phospholipid membrane of skeletal muscle (McGlory et al., 2014) mediated a direct protective effect on cell membrane integrity (indicative of muscle damage) and indirectly reduced muscle soreness. Given that serum CRP concentrations were similar between groups, in our hands the reduced muscle soreness in FO was not mediated by an anti-inflammatory response. To conclude, the benefit of whey protein ingestion to exercise recovery may be enhanced by the addition of n-3PUFA in competitive soccer players.

Table 1. The nutritional composition of supplement. Each supplement was taken twice a day for 6 weeks.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Volume (ml)</th>
<th>Energy Value (kcal)</th>
<th>Carbohydrate (g)</th>
<th>Fat (g)</th>
<th>Protein (g)</th>
<th>Vitamin D (μg)</th>
<th>n-3PUFA (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHO</td>
<td>200</td>
<td>200</td>
<td>10</td>
<td>15</td>
<td>15</td>
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<td>0</td>
</tr>
<tr>
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<td>200</td>
<td>200</td>
<td>10</td>
<td>15</td>
<td>15</td>
<td>3</td>
<td>550</td>
</tr>
<tr>
<td>PRO</td>
<td>200</td>
<td>200</td>
<td>10</td>
<td>15</td>
<td>15</td>
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<td>0</td>
</tr>
</tbody>
</table>

Figure 1 - Schematic diagram of experimental protocol. Measurements of muscle soreness, anti-inflammatory markers, muscle function were collected before and during the recovery period (24, 48 and 72 h).

Figure 2 - Percentage change in serum creatine kinase (CK) concentration. * Significantly different from FO. # Tendency (p<0.05) to be different from FO.

Figure 3 - Percentage change in serum reactive protein (CRP) concentration prior to, and during 72h recovery period from EIMD.

Figure 4 - Percentage change in maximum voluntary contraction of the dominant leg prior to, and during 72h recovery period from EIMD.

Figure 5 - Percentage change in serum interleukin (IL) concentration. * Significantly different from FO. # Tendency (p<0.05) to be different from FO.

Figure 6 - Percentage change in serum c-reactive protein (CRP) concentration prior to, and during 72h recovery period from EIMD.

DISCUSSION

1. Six wk of supplementation with a fish oil-rich, protein-based, carbohydrate-containing beverage reduced muscle soreness following intense exercise in competitive soccer players.
2. Given that serum CRP concentrations were similar between groups, in our hands the reduced muscle soreness in FO was not mediated by an anti-inflammatory response.
3. The blunted CK response during exercise recovery in FO suggests the incorporation of n-3PUFA into the phospholipid membrane of skeletal muscle (McGlory et al., 2014) mediated a direct protective effect on cell membrane integrity (indicative of muscle damage) and indirectly reduced muscle soreness.
4. To conclude, the benefit of whey protein ingestion to exercise recovery may be enhanced by the addition of n-3PUFA in competitive soccer players.