**A SUB-MAXIMAL ECCENTRIC TRAINING COUPLING WITH EURYCOMA LONGIFOLIA JACKET SUPPLEMENTATION INDUCED QUADRICEPS MUSCULAR STRENGTH AND THICKNESS IN YOUNG ELITE RUGBY PLAYERS**

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**ABSTRACT**

Eurycomalongifolia Jack (ElJ) contains a useful organic compound proprietary for various medical purposes and was reported to able to stimulate the androgen hormones such as testosterone. However, its use for enhancing training and sports performance was unclear. Therefore, this study aimed to examine the effects of consuming ElJ supplementation when implementing submaximal eccentric training on quadriceps muscular strength and muscle thickness in elite athletes. Sixteen young elite rugby sevens players (21.5±1.5 years; 1.74±0.06m; 80.0±10.0kg) were randomly assigned to one of two groups that supplemented with either ElJ (400mg per day) or similar taste and appearance placebo (PLA). They performed a submaximal eccentric training 3 times a week for 6 weeks in which the load increased from 75% to 100% of concentric 1RM (5% increase/week). Dependent variables of one repetition maximum (1RM) concentric and eccentric strength during leg press; concentric and eccentric peak torque at speeds of 60°/s and 180°/s during isokinetic knee extension and flexion, respectively; isometric peak torque and muscle thickness (vastus medialis, vastus lateralis, and rectus femoris) were collected within a week prior to, and after the 6-week training period, and then analysed accordingly. Mixed ANOVA indicated a significant interaction was evidenced for concentric 1RM (p = 0.018). Significant changes (p < 0.05) for pre and post-test were detected for concentric and eccentric 1RM, peak torque at 60°/s and 180°/s (with the exception for concentric peak torque at 180°/s), isometric peak torque, and muscle thickness of the vastus medialis, vastus lateralis, and rectus femoris; however, no between-group differences were found. The results indicated that combined ElJ supplementation and eccentric sub-maximal training induced significant improvement of quadriceps strength and quadriceps muscle thickness in young elite rugby players.

**KEYWORDS:** Sub-Maximal Eccentric Training, Eurycoma Longifolia Jack Supplementation, Quadriceps Muscular Strength and Thickness, Young Elite Rugby Players

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**INTRODUCTION**

Eccentric training can result in a better stimulation of hypertrophy and mechanical tension. The hypertrophic response is thought as a result of the growth of tissues that can occur if the process of breakdown is greater. It is reported that through this breakdown there is an increase in local growth factors (W. Kraemer & N. Ratamess, 2005). Mechanical tension is a critical stimulus to increase strength and size of skeletal muscle(Hortobágyi, DeVita, Money, & Barrier, 2001). Thus, as a result of the ability to generate greater maximal forces during eccentric actions, eccentric training induces greater muscle hypertrophy than concentric training(Farthing & Chilibeck, 2003). Human studies show greater skeletal muscle protein synthesis following bouts of maximal eccentric than concentric exercise (Nickols-Richardson, Miller, Wootten, Ramp, & Herbert, 2007). Furthermore, acute resistance exercise comprising...
only eccentric or concentric actions, elicited similar rate of protein synthesis despite the markedly less relative mechanical load employed in the eccentric mode (Norrbrand, Fluckey, Pozzo, & Tesch, 2008).

In addition, the energy cost of eccentric exercise is comparably low, despite the high muscle force being generated. This makes eccentrics an appealing strategy for those wishing to gain additional strength and hypertrophy because of the fact that more volume can be performed without excessive fatigue. Exercise-induced hypertrophy from eccentric exercise is likely manifested by greater muscular tension under load. This is a situation that has been mechanistically explained to represent a reversal of the size principle of motor unit recruitment, resulting in fast-twitch motor units being preferentially recruited earlier in the process (Shepstone et al., 2005).

A number of studies described the importance of eccentric muscle actions as a key component of resistance training programs (Medina-Perez, Teixeira, Fernandez-Gonzalo, & de paz, 2014). Resistance training utilising eccentric protocols have been compared with other training paradigms to examine maximum strengths, hypertrophy, metabolic cost, muscle activation, fiber recruitment pattern as well perceived fatigue. It has been known that the muscle damage and pain induced by eccentric exercise is higher when compared to the normal training modalities (e.g. concentric exercise). Moreover, a greater adaptation for muscle mass and muscular strength have been reported, despite with shorter periods of training (Medina-Perez et al., 2014).

Eurycoma Longifolia Jack (ELJ) has been used for medical purposes for thousand years because of its compounds that may possess medicinal values. Its popularity as tropical herbal plants spread across Southeast Asian countries like Malaysia, Indonesia, and Vietnam. ELJ has been said to be useful to release fever, intestinal worms, dysentery, diarrhea, indigestion, and jaundice (Abdullah & Salleh, 2010). In Vietnam, the flower and fruits of ELJ are used to treat dysentery, and the root was used to treat malaria and fever (Maneenoon et al., 2015). Furthermore, ELJ was thought to promote general vitality with aging, invigorating sexual vitality, enhancing strength, muscle mass, supporting balanced mood, strengthening stress tolerance, and supporting energy and general health. In modern medicine, ELJ has been shown to help in lessening osteoporosis (Mohd Effendy, Mohamed, Muhammad, Naina Mohamad, & Shuid, 2012), anti-malaria (Maneenoon et al., 2015), antidiengue (George, M Chinnappan, & Biggins, 2018), and anticancer (Thu, Hussain, Mohamed, & Shuid, 2018).

Despite the health benefits of ELJ supplementation (S. M. Talbott, J. A. Talbott, A. George, & M. Pugh, 2013), the use of ELJ for sports performance remains unclear. However, the findings from the earlier studies indicated that ELJ may be an effective ergogenic aid for certain athletic abilities. This could be especially possible when appropriate dosage is consumed, and maybe a more pronounced benefit will be observed if it is used for a prolonged period as supplementation for training (S. M. Talbott et al., 2013).

Earlier study to determine ergogenic effects of ELJ on strength was that of study that investigated the effect of ELJ on testosterone, body composition, and muscle strength and size (Hamzah & Yusof, 2003). In this study, fourteen healthy men were asked to perform an intense strength training programme involving initial load of 60% RM (2 sets of 10 repetitions with one-minute rest between, for 10 stations or different exercises) on alternate days for five weeks. The results of this study suggest that water soluble extract of ELJ increased fat free mass, reduced body fat, and increased muscle strength and size, and thus may have an ergogenic effect. Other studies also showed improvement in strength with resistance training (C. K. Chen et al., 2014; Chee Keong Chen, Ooi, Abu Kasim, & Asari, 2019; Ooi, Afifah, Chen, & Asari, 2015; Rodrigues, Saslow, Garcia, John, & Keltner, 2009) or without resistance training (George, Udani, Abidin, & Yusof, 2018; Henkel et al., 2014) with various daily dosages from 100 to 400mg of ELJ per day in five to twelve weeks. Muscle strength and hypertrophy was proven
to be improved in association with increased in testosterone or testosterone availability (Muhamad, Chen, Ooi, & Abdullah, 2009). Several studies with ELJ has showed significant increase in testosterone after consumption (in four and five weeks of 200 and 400mg respectively) (Shawn M. Talbott, Julie A. Talbott, Annie George, & Mike Pugh, 2013; M. Tambi, 2006; M. I. Tambi, Imran, & Henkel, 2012).

Nevertheless, it was not clear if ELJ supplementation can be warranted for use with intended proven benefits during a periodised training plan especially in elite athletes training year. Therefore, the purpose of this study was to examine the effects of consuming ELJ supplementation when implementing a six-week submaximal eccentric training on strength and muscle thickness of the knee extensor in elite Rugby Sevens players. It was hypothesised that ELJ supplementation during a 6-week submaximal eccentric training would result in an improved strength and size for the knee extensors in elite rugby players.

METHODS

Participants
Sixteen male young rugby sevens players (age: 21.5 ± 1.5y, height: 1.74 ± 0.06m, weight: 80.0 ± 10.0kg) were recruited in this study. Inclusion criteria were as followed: participated in 2015 and 2017 SEA Games in rugby sevens and represented or played for state or national level for more than 5 years, injury free, have never been hospitalised in the last 2 years, no surgery or serious injury to the lower limbs in the last 3 years, and lastly did not consume any other supplement during the study duration.

The participants who were injured or pronounced unfit by the team doctor or skipped any training program more than once will be excluded from the data analysis. Only the completer data will be used. They were not allowed to engage in any physically demanding activities for 48 hours prior to the first testing session, and during the course of post-testing. A written informed consent was obtained from all participants. The study was conducted in accordance with the Declaration of Helsinki, and all procedures and protocols were approved by the Institutional Review Board (ISNR007/2019).

Experimental Design
A randomized, double-blinded, parallel design experiment was applied in this study. Participants were randomized base on ABBA procedure with an isometric strength torque data at 45° for knee extensors. In this format, a player with the highest isometric strength was placed to ELJ group, players with the second and third highest torque score to PLA (placebo) group, fourth best player to ELJ, and so on. No between-group significant difference in physical characteristics ($p > 0.05$). Participants were asked to refrain from taking any supplements other than that provided to them during the period of study. Furthermore, all participants stayed at the same dormitory were consumed a similar portion of meal to what they ate prior to each testing session and throughout the day. Supplement compliance and testing attendance had to be 100% to be included in the analysis. All testing sessions occurred at the same time of day. Familiarisation of testing equipment was done one week prior to baseline data collection (T1) which was taken 5 days before the program started. Baseline tests including 1RM concentric, 1RM eccentric, isokinetic dynamometer strength and muscle thickness. All the strength measurements were done in three separate days. Post-test (T2) were conducted 3 - 5 days after completion of 6-week training program. Figure 1 below shows the study design for submaximal eccentric training in 6 weeks’ intervention.
Supplementation

The participants in the experimental group ingested 4 capsules (1 capsule = 100mg; 400mg) of hot water extraction EIJ in powdered form and capsuled by BiotropicsSdnBhd i.e. Physta®, while the remaining participants ingested similar amount of look-alike capsule or placebo (PLA), i.e. maltodextrin. This carbohydrate-type content was chosen as a PLA as carbohydrate supplementation has not been shown to improve or impair the recovery from eccentric exercise (Miles, 2007). The capsule was designed to have the same shape, colour, and taste.

The participants were asked to take the supplement on day one up to the last day of the 6 weeks. A reminder was given on daily basis to consume the supplement after breakfast. The dosage of 400mg of EIJ has been selected in this study based on evidence that the supplementation of EIJ at a dosage of 400 mg/day for 6 weeks did not affect the urinary T:E ratio and hence will not breach any doping policies of the International Olympic Committee for administration of exogenous testosterone or its precursor since the participants were elite competitive athletes (C. K. Chen et al., 2014). In addition, the supplementation of water soluble EIJ extract at this dosage and duration was safe as clinical data demonstrated it did not adversely affect the liver and renal functions (M. Tambi, 2006).

One-Repetition Maximum

The 1 repetition maximum (1RM concentric) and eccentric maximal strength (1RM eccentric) test protocols were determined from a series of attempts using a 45° leg press (Cybex incline leg press machine). The test was conducted by certified trainers. Prior to the test, subjects were required to warm up on a stationary bicycle (LeMond, USA) and followed by light dynamic stretching. Subsequent to this, they performed maximal strength tests using the procedures that were modified from previous researchers (Phillips, Batterham, Valenzuela, & Burkett, 2004; Wirth, Keiner, Szilvas, Hartmann, & Sander, 2015).

About 2-3 minutes’ rest was given after the warm-up. For safety purposes, two straps that have a towing capacity of 600kg was used in addition to the standard manual stoppers attached to the leg press machine. It was able to stop the carriage if subjects could not control the heavy load. Participants were also being advised to avoid excessive lordosis of the lumbar spine. During the 1RM and eccentric maximal tests, participants sat in the leg press bench with both feet outstretched on the foot plates with a knee angle of 180°. When the carriage was lowered, a goniometer was used to visually demonstrate the
attainment of a 90° knee angle.

Participants performed multiple repetitions at loads equal to 30% (8–10 repetitions), 50% (4–6 repetitions), 70% (2–4 repetitions), and 90% (1 repetition) of the estimated 1RM. The resistance was progressively increased using 10-20kg loads. After each successful performance, 3–5 minutes’ rest was given prior to the next attempt. Participants were given up to 5 maximal attempts to achieve a 1RM after the warm up sets of: 30% of estimated 1RM, done at 8-10 reps, 50% of estimated 1RM, done at 4-6 reps, 70% of estimated 1RM, done at 2-4 reps, 90% of estimated 1RM, done at 1 rep.

**1RM Eccentric Protocol**

The procedure of 1RM eccentric assessment was adopted (Wirth et al., 2015). In the 1RM eccentric test, eccentric phase was required to last for 4-5 seconds with a knee joint angle smaller than 90° in order to be considered valid. After reaching the 90° angle, the carriage was brought to the starting position by the trainers (assisted). The movement range was visually monitored by trainers. If participants could not prevent a faster lowering of the carriage (i.e. less than 4 seconds), the repetition was considered invalid. Participants were given 4–5 minutes of rest between the individual attempts.

The maximum strength protocol was adopted from the guideline of the National Strength and Conditioning Association (Richens & Cleather, 2014). Briefly, participants were asked to perform a warm-up set that consists of 50, 70, and 90% of individual 1 repetition maximum for 10, 5, and 3 repetitions, respectively. Subsequent to this, they were asked to perform 1 repetition of the next three load intensities: 100% and 120% of concentric strength, and after that, if successful, to attempt 140%. After each successful test, the load was further increased (20-40kg) or decreased (10-20kg) until failed, or a maximum of 5 further attempts, which was adequate to achieve maximum strength by all participants.

**Isokinetic Dynamometer**

Familiarization of testing protocols were conducted seven days prior the pre-data collection session. Calibration of isokinetic machine performed according to manufacturer’s standard guideline prior every testing session. Participants were given 10 minutes of warm-up duration which consist of five minutes of cycling on cycle ergometer (Monark, USA) at 60 rpm with free load (zero watt), 10 repetitions of ‘full squat and stand-up’ and stretching exercises.

Participants were asked to sit on the dynamometer chair and the thigh, pelvis and trunk was secured by the belts to prevent additional body movement. Both arms are required to hold on the chair’s handle. The dynamometer chair set inclination of about 10 degrees upwards. The lateral femoral epicondyle used to align the knee joint with the axis of rotation of the dynamometer adapter. Participants were tested by an isokinetic dynamometer (Humac Norm, CSMI USA) at three sets of three repetitions of knee isokinetic concentric-eccentric contraction at 60 and 180 degrees per second on dominant leg.

The testing range of motion of knee joint is 90 degrees (80 - 170-degree relative knee joint angle). Two minutes interval rest were given in between each set. Participants were tested by an isokinetic dynamometer (Humac Norm, CSMI USA) at three repetitions of six second of knee isometric contraction at 135 degrees on dominant leg. Two minutes interval rest was given in between each repetition. Participants were required to perform with their full efforts throughout the test. Verbal encouragement was given throughout the test session. Data were collected for the parameters of peak torque.

**Muscle Thickness**
Measurement of quadriceps thickness (anterior thigh of the dominant leg) were done by using B-mode Ultrasound Imaging Portable machine (GE, LOGIQ e, Connecticut, USA) with an electronic linear transducer of 10 MHz imaging or repetition frequency, using a gain of 58 dB, and a magnification which allows a depth of 30 mm. To locate the measurement sites, an anthropometric tape measure was placed along the length of the thigh from the superior tip of the patella to the anterior superior iliac spine with subject in standing position. A non-toxic pen was then used to mark each muscle.

The vastus medialis was defined at 20% of the distance, and at 50% for both rectus femoris and vastus lateralis (Narici & Boer, 2011). The actual location of the vastus medialis was 12.5% of thigh circumference in the medial direction (towards midline) from the mid-point, and 10% in the lateral direction for the vastus lateralis. During the scanning process, participants lay relaxed in supine lying with a rolled-up towel placed in the popliteal fossa to relax the upper thigh.

The transducer was positioned perpendicular to the longitudinal axis of quadriceps muscle with ultrasound gel placed between the probe and the skin, with minimal pressure, to obtain a real-time cross-sectional image (i.e. muscle thickness). Muscle thickness was determined as the distance from the adipose tissue-muscle interface to the muscle-bone interface. A trained operator captured three measurements for each muscle and averaged for analysis. All images were downloaded and stored in a compact flash card to enable off-line measurements of the muscle dimensions. The measurement was done in the morning before any physical exertion during baseline testing and post-testing.

Eccentric Training Procedures

The training protocol was adopted from a training guideline for eccentric training (Mike, Kerksick, & Kravitz, 2015). There were three sessions of strength training a week which were conducted for six weeks. The main strength exercise employed was the leg press using a 45° leg press machine (Cybex incline leg press machine). The use of leg press was sought to primarily target the knee extensor muscles (Da Silva, Brentano, Cadore, De Almeida, & Kruel, 2008). During each training session, subjects were asked to lower the carriage to a knee angle of 90° in a controlled fashion, which were then be moved or pulled upward by at least two spotters to complete each repetition. The depth of the downward movement was visually monitored so that the carriage is lowered down to a marked line to indicate a 90° knee angle has been reached. Subjects were asked focus on eccentric control throughout the movement while the spotters were required to perform the entire concentric movement.

For muscle strength and hypertrophy, load ranging from 70-100% of 1RM concentric in ACSM Position Stand (Kraemer, Ratamess, & French, 2002; Ratamess et al., 2009). The tempo of eccentric training was controlled so that each movement was done with approximately 4 to 5s (Mike et al., 2015). Subjects in training group were asked to perform 3 sets of 5 repetitions eccentric training in order to induce both strength and hypertrophic adaptations (Leite et al., 2014; Radaelli et al., 2015). Longer rest were given (3 to 5 minutes) between sets for each subject due large demand on the nervous system. The concentric phases of each repetition was done with external assistance (i.e. partner assisted) as per Table 1.

Table 1: Training Protocol for 6 Weeks
A Sub-Maximal Eccentric Training Coupling with Eurycoma Longifolia Jack Supplementation
Induced Quadriceps Muscular Strength and Thickness in Young Elite Rugby Players

<table>
<thead>
<tr>
<th>Set</th>
<th>Rep</th>
<th>Load</th>
<th>Tempo</th>
<th>Rest</th>
<th>Total Number of Sessions</th>
<th>Total Number of Sets</th>
<th>Total Number of Reps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>3</td>
<td>5</td>
<td>75%</td>
<td>5-0-A</td>
<td>3-5'</td>
<td>3</td>
<td>9</td>
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<tr>
<td>Week 2</td>
<td>3</td>
<td>5</td>
<td>80%</td>
<td>5-0-A</td>
<td>3-5'</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Week 3</td>
<td>3</td>
<td>5</td>
<td>85%</td>
<td>5-0-A</td>
<td>3-5'</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Week 4</td>
<td>3</td>
<td>5</td>
<td>90%</td>
<td>5-0-A</td>
<td>3-5'</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Week 5</td>
<td>3</td>
<td>5</td>
<td>95%</td>
<td>5-0-A</td>
<td>3-5'</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Week 6</td>
<td>3</td>
<td>5</td>
<td>100%</td>
<td>5-0-A</td>
<td>3-5'</td>
<td>3</td>
<td>9</td>
</tr>
</tbody>
</table>

Statistics

Two-factor mixed-design ANOVA was utilized to assess interaction, between-group or treatment (PLA vs EIJ), and within-subject or time-effect difference for dependent variables (pre and post): 1RM concentric and eccentric leg press, isokinetics strength and muscle thickness. Paired t-tests were used to detect for group and time. Simple percent difference was calculated using the following formula: ([post-test - pre-test]/pre-test x 100). All data was presented as mean ± standard deviation (SD). The accepted level of significance was set at \( p < 0.05 \) for all statistical tests. All data were analysed using the Statistical Package for the Social Sciences version 22 (SPSS Inc., Chicago, IL).

RESULTS

1RM Concentric and 1RM Eccentric Leg Press

![Figure 2: The Figure Shows the Means (and SD) for Concentric Leg Press (in Kg) for the EIJ and Placebo Groups for Pre- and Post-Test.](image)

In Figure 2, there was a significant interaction between time and group \([F(1, 14) = 7.150, p = 0.018 (\eta^2 = 0.338)]\) and significant main effect of time \([F(1, 14) = 104.316, p = 0.001 (\eta^2 = 0.882)]\) were detected, without significant difference between groups \([F(1, 14) = 0.132, p = 0.722 (\eta^2 = 0.009)]\).
In Figure 3, there was no significant interaction between time and group [F (1, 14) = 0.957, p = 0.345 (ηp² = 0.064)], there was a significant main effect of time [F (1, 14) = 167.377, p = 0.001 (ηp² = 0.923)], and no significant between-group difference [F (1, 14) = 0.002, p = 0.964 (ηp² = 0.000)] were detected.

### Isokinetic and Isometric Strength

<table>
<thead>
<tr>
<th>Variable</th>
<th>PLA</th>
<th>ELJ</th>
<th>PLA</th>
<th>ELJ</th>
<th>PLA</th>
<th>ELJ</th>
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<tbody>
<tr>
<td>Concentric leg press (kg)</td>
<td>Pre Mean(SD)</td>
<td>Post Mean(SD)</td>
<td>Diff. (%)</td>
<td>Pre Mean(SD)</td>
<td>Post Mean(SD)</td>
<td>Diff. (%)</td>
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<tr>
<td></td>
<td>513 ± 38</td>
<td>566 ± 42</td>
<td>10.3</td>
<td>485 ± 59</td>
<td>578 ± 39</td>
<td>19.2</td>
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<td>8.8</td>
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<tr>
<td>Eccentric leg press (kg)</td>
<td>688 ± 61</td>
<td>856 ± 54</td>
<td>24.4</td>
<td>673 ± 84</td>
<td>869 ± 37</td>
<td>29.1</td>
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<td>4.7</td>
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<tr>
<td>Knee extension 60°/s (Nm/kg)</td>
<td>261 ± 38</td>
<td>274 ± 25</td>
<td>5.0</td>
<td>262 ± 33</td>
<td>282 ± 45</td>
<td>7.6</td>
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<td>2.7</td>
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<tr>
<td>Knee extension 180°/s (Nm/kg)</td>
<td>174 ± 30</td>
<td>179 ± 29</td>
<td>2.9</td>
<td>149 ± 22</td>
<td>168 ± 22</td>
<td>12.8</td>
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<td>9.9</td>
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<tr>
<td>Knee flexion 60°/s (Nm/kg)</td>
<td>311 ± 67</td>
<td>360 ± 53</td>
<td>15.8</td>
<td>348 ± 67</td>
<td>370 ± 48</td>
<td>6.3</td>
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<td>9.4</td>
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<tr>
<td>Knee flexion 180°/s (Nm/kg)</td>
<td>293 ± 51</td>
<td>332 ± 25</td>
<td>13.3</td>
<td>325 ± 28</td>
<td>339 ± 41</td>
<td>4.3</td>
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<td></td>
<td></td>
<td></td>
<td>9.0</td>
</tr>
<tr>
<td>Isometric (Nm/kg)</td>
<td>261 ± 29</td>
<td>329 ± 40</td>
<td>26.1</td>
<td>252 ± 27</td>
<td>305 ± 62</td>
<td>21.0</td>
</tr>
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<td></td>
<td>5.0</td>
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</tbody>
</table>

As presented in Table 2, there was no significant interaction between time and group F(1,14) = 0.316, p = 0.583 (ηp² = 0.220). There was a significant main effect of time, F(1,14) = 6.173, p = 0.026 (ηp² = 0.306). There was no significant main effect of group, F(1,14) = 0.062, p = 0.807 (ηp² = 0.004).

There was no significant interaction between time and group F(1,14) = 1.07, p = 0.319 (ηp² = 0.071). There was no significant main effect of time, F(1,14) = 2.98, p = 0.106 (ηp² = 0.176). There was no significant main effect of group, F(1,14) = 2.773, p = 0.118 (ηp² = 0.165).

There was no significant interaction between time and group F(1,14) = 1.146, p = 0.303 (ηp² = 0.076). There was a significant main effect of time, F(1,14) = 8.130, p = 0.013 (ηp² = 0.367). There was no significant main effect of group, F(1,14) = 0.744, p = 0.403 (ηp² = 0.050).

There was no significant interaction between time and group F(1,14) = 1.90, p = 0.190 (ηp² = 0.119). There was a significant main effect of time, F(1,14) = 8.37, p = 0.012 (ηp² = 0.374). There was no significant main effect of group, F(1,14) = 1.434, p = 0.251 (ηp² = 0.093).

There was no significant interaction between time and group F(1,14) = 0.36, p = 0.561 (ηp² = 0.025). There was a significant main effect of time, F(1,14) = 22.56, p = 0.0005 (ηp² = 0.617). There was no significant main effect of group,
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$F(1, 14) = 0.956, p = 0.345 (\eta^2 = 0.064)$.

Muscle Thickness

Table 3: Changes in Muscle Thickness Before and After Submaximal Eccentric Training

<table>
<thead>
<tr>
<th>Muscle Thickness</th>
<th>PLA</th>
<th></th>
<th>ELJ</th>
<th></th>
<th>Diff. (%)</th>
<th>Bet. Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre (SD)</td>
<td>Post (SD)</td>
<td>Diff. (%)</td>
<td>Pre (SD)</td>
<td>Post (SD)</td>
<td></td>
</tr>
<tr>
<td>Vastus medialis (cm)</td>
<td>3.68 (0.5)</td>
<td>3.69 (0.51)</td>
<td>0.2</td>
<td>3.43 (0.35)</td>
<td>3.60 (0.37)</td>
<td>4.7</td>
</tr>
<tr>
<td>Vastus lateralis (cm)</td>
<td>3.23 (0.31)</td>
<td>3.25 (0.34)</td>
<td>0.7</td>
<td>3.15 (0.33)</td>
<td>3.31 (0.36)</td>
<td>3.6</td>
</tr>
<tr>
<td>Rectus femoris (cm)</td>
<td>2.90 (0.26)</td>
<td>2.94 (0.26)</td>
<td>1.4</td>
<td>2.77 (0.16)</td>
<td>2.90 (0.13)</td>
<td>5.8</td>
</tr>
</tbody>
</table>

Results obtained showed that there was a significant interaction between time and group, $F(1, 14) = 9.097, p = 0.009 (\eta^2 = 0.394)$. There was a significant main effect of time, $F(1, 14) = 10.943, p = 0.005 (\eta^2 = 0.439)$. There was no significant main effect of group, $F(1, 14) = 0.597, p = 0.453 (\eta^2 = 0.041)$.

Also, there was a significant interaction between time and group, $F(1, 14) = 8.645, p = 0.011 (\eta^2 = 0.382)$. There was a significant main effect of time, $F(1, 14) = 19.274, p = 0.001 (\eta^2 = 0.597)$. There was no significant main effect of group, $F(1, 14) = 0.045, p = 0.834 (\eta^2 = 0.003)$.

Results revealed that there was no significant interaction between time and group, $F(1, 14) = 3.623, p = 0.078 (\eta^2 = 0.206)$. There was a significant main effect of time, $F(1, 14) = 10.063, p = 0.007 (\eta^2 = 0.418)$. There was no significant main effect of group, $F(1, 14) = 0.397, p = 0.539 (\eta^2 = 0.028)$.

DISCUSSIONS

The purpose of this study was to assess the effects of ElJ supplementation when implementing in a 6-week submaximal eccentric training on quadriceps muscular strength and thickness in Malaysian rugby sevens players. There were two major findings of the study: (a) a 6-week periodized training incorporating eccentric protocol did not yield a significant between-group difference for various physiological and anthropometric measures; and (b) despite no between-group difference, most of within-group comparisons yielded significant difference, indicating improvement of the tested variables over time, irrespective of treatment (ElJ vs PLA). This key finding of this study did not support the original hypothesis that the ingestion of ElJ supplementation would induce a positive benefit to the neuromuscular functions, such as both eccentric and concentric strength and muscle thickness.

In the present study, the eccentric training modality was performed in a progressive manner utilising submaximal load intensity ranging from 75% to 100%. Although no previous studies have examined the effects of ElJ on strength among elite athletes, a study that was conducted on healthy adult males (28 ± 2.5 years) reported that consumption of 100 mg/day of ElJ extract during an 8-week of training resulted in significant improvements in fat-free mass, fat mass, maximal strength (1RM) and arm circumference when compared to a placebo group (Hamzah & Yusof, 2003).

In contrast to this, the present study found that there was no statistical difference ($p > 0.05$) was obtained for the comparisons between ElJ and PLA for the concentric and eccentric leg press. However, a simple percent difference indicated that ElJ group had higher increases in both concentric (19.2%; pre and post-test) and eccentric (29.1%; pre and post-test) strength as compared to PLA (10.3% and 24.4%, respectively). Similarly, results in mean concentric
peak torque of the knee extensors (60 and 180 deg/sec) yielded no statistical difference ($p > 0.05$). However, the pre-test to post-test results during the 60 deg/sec seemed to increase dissimilarly, 7.6% and 5.0% for the EIJ and PLA groups, respectively. This was also similar for the 180 deg/sec velocity.

Interestingly, the isokinetic eccentric contraction of peak torque test was done at 60 deg/sec exhibited a significant improvement ($p < 0.05$) from pre-test to post-test for both the EIJ (6.3%) and PLA (15.8%). This was however not achieved during the 180 deg/sec velocity, but there was a slightly more increase in PLA (13.3%) as compared to EIJ (4.3%). Also, these results were in agreement with previous findings that a combination of circuit training with EIJ elicited beneficial effect on isokinetic muscular strength(Ooi et al., 2015). In the present study, the isometric contraction of peak torque test was done at a knee angle of 45 degree of knee extension, exhibited a significant improvement from pre-test to post-test ($p < 0.05$) for both the supplement (21.0%) and placebo group (26.1%).

It is plausible that the similar outcomes between groups may be attributed to the day to day training, including the rugby conditioning workouts, as well as the submaximal eccentric training which was similar for both groups. Furthermore, elite rugby players were generally well built and robust in physical characteristics from several years of training. Consequently, their strength training demands also higher for various types of strength workouts, which could have not influenced by the EIJ supplementation(Kelly & Coutts, 2007). It was however apparent that, although statistical difference was only obtained for the higher isokinetic eccentric strength at lower speed and the isometric strength, there seems a tendency for the EIJ group to respond better than PLA after the period of eccentric training.

Therefore, lack of statistical difference observed for the pre- and post-test between group comparisons could have been due to ‘short time frame’ period (i.e. 6 weeks) for development of these explosive parameters. Furthermore, the fact that the positive results were obtained in a study in which well-trained athletes (average 9 hours training per week) were included, small increases in speed and power outputs would have been substantial. Indeed, it becomes exceedingly more difficult for trained individuals to gain further increase in strength and performance compared to untrained individuals(Ahtiainen, Pakarinen, Alen, Kraemer, & Häkkinen, 2003; Peterson, Rhea, & Alvar, 2005).

Eccentric training yielded a larger increase in muscle thickness, as measured from the vastus lateralis, rectus femoris, and vastus medialis muscles, despite achieving not statistically significant between groups. This suggests that mechanical overload (e.g. eccentric actions) contributed the development of muscle thickness for the knee extensor muscles, more than the influence of the supplement in the present study. The results from pre and post-test from both groups showed muscle thickness significantly increased ($p < 0.05$) over time. However, the magnitude of increase from EIJ was generally higher than PLA based on percent change, with 4.5, 2.9, and 4.4% more increase in EIJ than did by PLA after 6 weeks ($p > 0.05$). These hypertrophied muscles could have been due to activation of the mTOR (mammalian target of rapamycin) signalling pathway resulting from the simultaneous action of protein ingestion with training(Farnfield, Breen, Carey, Garnham, & Cameron-Smith, 2012) and testosterone (Bhasin et al., 1996).

It is well known that serum level of testosterone can be acutely or chronically elevated after resistance training (Haddad et al., 2007; West & Phillips, 2012) thus resulting in permanent role in mediating muscle hypertrophy in response to training. Anabolic effects are mediated via interaction of testosterone with androgen receptor that leads to upregulation of several muscle specific transcript for hypertrophy (W. J. Kraemer & N. A. Ratamess, 2005; Roberts et al., 2018). EIJ with its aphrodisiac property showed evidence in increasing one’s testosterone level in a human trial study(M. I. Tambi et al., 2012).
A Sub-Maximal Eccentric Training Coupling with Eurycoma Longifolia Jack Supplementation Induced Quadriceps Muscular Strength and Thickness in Young Elite Rugby Players

The possible mechanism in elevating production of androgens especially testosterone is by compensating lowered circulation of estrogen due to anti-estrogenic activity by ElJ which work as a selective estrogen receptor modulator (Cuzick et al., 2013). Thus, the increase in muscle thickness with ElJ supplementation may translate to improved strength. Although no statistical difference, the improvement in strength that was observed in ElJ was parallel to that achieved for the muscle thickness, as compared to PLA. This lack of difference in muscle thickness between groups remains unclear but could be attributed to aforesaid factors such as the participants training characteristics that was similar and influences from testosterone either through training or ElJ. Nevertheless, such result is not entirely surprising due to the characteristics of ElJ supplementation that has not been shown to be substantial in elite athletes for various parameters of performance or being tested with this cohort of participant from the previous studies.

ElJ supplementation is more widely used and has been suggested to increase certain areas of physical fitness, apart from health benefit (S. M. Talbott et al., 2013). Scientific evidence supports the use of ElJ has not been conclusive, especially for well-trained athletes. Eurycomanone, protein, polysaccharides, and glycosaponin are the predominant markers or contents of ElJ, which are believed important for health, while enhancing the muscular strength (M. Tambi, Musa, & Henkel, 2011).

Consumption of ElJ enable the stimulation of the androgenic effect such by increasing the testosterone levels to potentially assist in a greater force generation (Hamzah & Yusof, 2003). In other supplementation studies, it was reported that ingestion of the caffeine-containing supplement resulted in an acute increase in upper-body strength in resistance-trained men (Beck et al., 2006). The positive outcomes from this study were resulted from the increase of force production as a result of enhancement of neuromuscular transmission, as well as improvement in the ability to achieve maximal muscle activation (Beck et al., 2006). Although with a limited comparison can be done, a recent study that was tested among non-athlete’s population supported the outcomes of the present study. The recent study concluded that significant increases were observed in average power during isokinetic of knee flexion (300°/s) after an eight-week of intervention, for both ElJ and control group or without ElJ (Chee Keong Chen et al., 2019).

There were several limitations in current study which was limited sample size (8 per group). Increasing the sample size in each group would likely increase the power of analysis and allow a greater chance of identifying significant difference. It was not possible to include more subjects for this study due to limited number elite athletes from the chosen sports, and further recruitment was impossible. Furthermore, individualised amount of supplement given could have changed the effect observed.

Although this study did not find statistical difference between ElJ and placebo, further understanding regarding the use of ElJ among elite athletes are necessary. The selected dosages, study duration, types of training, age of participants and possibly the form of ElJ should be put into consideration in determining the possible synergistic influence of ElJ towards highly trained athletes. All in all, a trend towards positive outcomes in various parameters were in favour of ElJ, the androgenic effect of ElJ was likely essential to enhance adaptation to training. Hence, further investigations on ElJ supplementation for sports performance is warranted.

In conclusion, this study demonstrated the effects of ElJ supplementation among athletes, and that some changes did occur (i.e. improvement in muscle function) as a result of consuming ElJ, nevertheless the clinical significance of these changes were unclear, or perhaps, negligible. Collectively, results indicated that effects of ElJ supplementation and eccentric sub-maximal training on physiological parameters (quadriceps muscle strength and thickness), were significant within
groups for the elite athletes used in the present study.

The current dosage of ElJ supplementation with an appropriate composition and administration might benefit on health and general muscular performance, which did not seem imperative to young elite athletes of this age group. Of note, it is widely known that eccentric exercise is associated with muscle damage that could result in impaired muscle function and performance. Hence, the use of ElJ supplementation during eccentric training could be more beneficial, by enhancing recovery and improving muscle function. However, this contention as a means to improve training quality and athletic performance is subjected to further investigation. It appears that combination of ElJ plant as an ergogenic aid, combined with strength training for enhancing strength is promising, but remain a subject of exploration. Nevertheless, studies in this area are still lacking and no study have examined its effects on highly trained athletes.

REFERENCES


NeuroRehabilitation, 34. doi:10.3233/NRE-141062


50. SUDHAKAR, S., and CV SENTHIL NATHAN. "EFFECTS OF DEEP STRIPPING MASSAGE WITH ECCENTRIC RESISTANCE VERSUS STATIC STRETCH WITH CRYOTHERAPY ON IMPROVING CALF MUSCLE FLEXIBILITY." International Journal of Physiotherapy & Occupational Therapy (TJPRC: IJPOT) 2.2 (2016):45-50


52. KHURANA, TANVI, and SUMAN SINGH. "UNDERSTANDING STATIC MUSCULAR CONTRACTIONS AND BODILY MOVEMENTS." International Journal of Applied and Natural Sciences (IJANS) 6.4 (2017):91-96

53. SUDHAKAR, S., and CV SENTHIL NATHAN. "EFFECTS OF DEEP STRIPPING MASSAGE WITH ECCENTRIC RESISTANCE VERSUS STATIC STRETCH WITH CRYOTHERAPY ON IMPROVING CALF MUSCLE FLEXIBILITY." International Journal of Physiotherapy & Occupational Therapy (TJPRC: IJPOT) 2.2 (2016):45-50