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METHOD FOR ASSESSING THE TRAINING OF ELITE FOOTBALL PLAYERS

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Abstract:
In order to conduct scientific sports training, it is necessary to use appropriate methods that highlight the energetic parameters. The experimental method developed by Miron Georgescu originates from the test for determining the anaerobic capacity of effort in a force - velocity maximal effort test. The paper presents the energetic parameters of the football players of the team that has lead the national championship, together with the data analysis accordingly. The paper presents the estimation of football players' physical preparation using the energetic parameters experimentally established.

Key-words*: average unit power, average flying height, repetition rate*

1. INTRODUCTION

Sports competition is the engine of sports development and also offers the opportunity to check the athletes' status of training. During the competition, the athletes prove the quality of their training, value the previous training stage, enrich their experience. The trainers must conceive such a physical preparation that takes into account the competition, as a method to reach the maximum preparation stage.

That is why, it is very important to determine the energetic parameters for the football players, at different stages of training, before the championship, at the middle at the end of the championship.

The proposed experimental study emphasizes the general energetic resources of a football player, considering that the muscle tissue has, besides motor qualities, elasticity and viscosity (Almeida, Hong, Corcos, and Gottlieb - 1995).

2. EXPERIMENTAL METHOD

The proposed experimental method is called the MGM-15 test (Mereuta & Mereuta – 2010, MGM test description) and consists of a series of 15 vertical jumps. The human performance is evaluated using a series of repeated vertical jumps, on a special carpet, connected to a computer, by measuring the time of ground contact, respectively, the flying time. The data are processed mathematically or statistically according to necessities, considering that the mean of the ground contact time (170-180 ms.) during the jump on both legs is smaller than the reaction time measured during jumping on one leg (300 ms.).

The test protocol requires 3 series of 15 vertical jumps, on both legs, on right leg and on left leg. The program removes five of vertical jumps, considering for further analysis only ten of them.

The energetic parameters involved in this experiment are: average unit power (AUP), the

average flying height (AFH), and the repetition rate (RR).

2.1. The average unit power (AUP)

AUP is the energetic parameter that provides information on the force-velocity ratio and on the conditional training of football players. AUP can be determined using the formula:

$$AUP = \frac{\frac{g}{8} \cdot \sum_{i=1}^{10} Ta_i^2}{\sum_{i=1}^{10} \left(Ta_i + Ts_i \right)} \quad (1)$$

where:

T_{ai} is the flying time for the jump "i"

T_{si} is the ground contact time for the jump "i".

2.2. The average flying height (AFH)

AFH provides information mainly on the force and we highlight that this parameter is different from the detent, which is measured directly from the hand to the ground. AFH can be determined using the formula:

$$AFH = \frac{\frac{g}{8} \cdot \sum_{i=1}^{10} Ta_i^2}{10} \quad (2)$$

where:

T_{ai} is the flying time for the jump "i"

2.3. The repetition rate (RR)

RR is an energetic parameter that represents, in fact, the average contact ground time and provides information mainly on the velocity, distinguishing the excitation and inhibition processes of nerve cells and the relaxation and contraction processes in muscles.

RR can be determined using the formula:

$$RR = \frac{\sum_{i=1}^{10} Ts_i}{10} \quad (3)$$

where:

T_{si} is the ground contact time for the jump "i". The values of this parameter reveal the velocity during effort. Thus, the data from literature range the velocity as follows:

$RR \in [160, 165] ms$ - very good;

$RR \in [170, 180] ms$ - medium (normal);

$RR \geq 200\, ms$ - very low.

3. RESULTS

For the experimental phase a group of 25 football players from the former leader of the Romanian Championship volunteered to participate in the study. All procedures had the prior approval of University's Ethics Committee. After the general purpose of the investigation was explained, sport managers, trainers and all participants gave their consent to conduct the study. They were tested using MGM-15 test. For each of the participants, the test provides the ground contact time and the flying time when they performed vertical jumps on both legs, on right and on left leg. The measured data are revealed in table 1, only for five of them.

Their energetic parameters are discussed and analyzed, with the respect to the standard values from literature.

Table 1 – Experimentally data - extract

S1	Both	Ground	0.243	0.161	0.17	0.167	0.183	0.163	0.17	0.201	0.211	0.174
	legs	Air	0.555	0.5	0.525	0.524	0.563	0.537	0.546	0.543	0.542	0.572
	Right	Ground	0.297	0.303	0.271	0.255	0.289	0.249	0.247	0.252	0.26	0.262
	leg	Air	0.355	0.389	0.366	0.4	0.366	0.417	0.39	0.402	0.415	0.383
	Left	Ground	0.354	0.271	0.237	0.269	0.277	0.259	0.248	0.238	0.262	0.243
	leg	Air	0.356	0.402	0.406	0.409	0.448	0.354	0.405	0.411	0.402	0.408
S2	Both	Ground	0.235	0.196	0.189	0.2	0.184	0.18	0.217	0.185	0.179	0.339
	legs	Air	0.558	0.563	0.573	0.567	0.609	0.573	0.559	0.608	0.569	0.426
	Right	Ground	0.327	0.3	0.256	0.258	0.255	0.255	0.267	0.261	0.23	0.253
	leg	Air	0.444	0.459	0.465	0.44	0.492	0.445	0.46	0.487	0.463	0.462
	Left	Ground	0.285	0.273	0.303	0.266	0.272	0.283	0.269	0.25	0.27	0.254
	leg	Air	0.449	0.465	0.393	0.472	0.456	0.472	0.447	0.454	0.509	0.453
S3	Both	Ground	0.209	0.228	0.221	0.238	0.185	0.247	0.201	0.21	0.226	0.223
	legs	Air	0.594	0.562	0.577	0.549	0.578	0.58	0.581	0.566	0.575	0.583
	Right	Ground	0.362	0.355	0.339	0.352	0.345	0.327	0.353	0.343	0.315	0.329
	leg	Air	0.426	0.456	0.452	0.432	0.427	0.428	0.47	0.423	0.406	0.441
	Left	Ground	0.359	0.335	0.39	0.337	0.288	0.31	0.331	0.338	0.411	0.32
	leg	Air	0.439	0.442	0.451	0.457	0.439	0.452	0.445	0.454	0.407	0.433
S4	Both	Ground	0.274	0.202	0.209	0.213	0.2	0.176	0.163	0.176	0.22	0.207
	legs	Air	0.593	0.6	0.593	0.606	0.597	0.604	0.583	0.594	0.612	0.599
	Right	Ground	0.283	0.285	0.245	0.287	0.252	0.273	0.307	0.296	0.311	0.271
	leg	Air	0.475	0.444	0.467	0.494	0.451	0.479	0.488	0.474	0.43	0.501

	Left leg	Ground	0.319	0.285	0.305	0.285	0.311	0.277	0.339	0.285	0.281	0.276
		Air	0.486	0.496	0.441	0.459	0.525	0.512	0.49	0.478	0.505	0.477
S5	Both legs	Ground	0.229	0.22	0.218	0.212	0.2	0.213	0.212	0.2	0.235	0.199
		Air	0.504	0.505	0.521	0.506	0.54	0.518	0.529	0.541	0.527	0.547
	Right leg	Ground	0.291	0.302	0.298	0.324	0.306	0.281	0.281	0.297	0.327	0.282
		Air	0.442	0.427	0.434	0.427	0.405	0.379	0.364	0.414	0.398	0.404
	Left leg	Ground	0.292	0.326	0.272	0.31	0.285	0.261	0.263	0.293	0.308	0.293
		Air	0.444	0.412	0.41	0.445	0.471	0.434	0.419	0.404	0.442	0.451

Based on these data, the energetic parameters are computed and the results are shown in table 2 and fig.1

Table 2 Energetic parameters

Participants	Vertical jump on both legs			Vertical jump on right leg			Vertical jump on left leg		
	AUP	AFH	RR	AUP	AFH	RR	AUP	AFH	RR
S1	4.85	0.35	0.18	2.77	0.18	0.27	2.9	0.19	0.27
S2	4.93	0.38	0.21	3.52	0.26	0.27	3.45	0.25	0.27
S3	5	0.4	0.22	2.94	0.23	0.34	3	0.23	0.34
S4	5.36	0.43	0.2	3.55	0.27	0.28	3.65	0.29	0.3
S5	4.47	0.33	0.21	2.85	0.2	0.3	3.12	0.23	0.29
S6	5.33	0.44	0.22	3.16	0.25	0.33	3.66	0.29	0.3
S7	5.66	0.47	0.21	3.38	0.27	0.32	3.77	0.31	0.33
S8	5.19	0.39	0.18	3.38	0.27	0.32	3.64	0.27	0.26
S9	5.31	0.43	0.21	3.22	0.23	0.28	3.28	0.25	0.3
S10	4.83	0.37	0.22	3.61	0.27	0.28	3.23	0.24	0.3
S11	5.72	0.46	0.18	3.81	0.29	0.27	4.25	0.33	0.26
S12	5.53	0.43	0.18	3.66	0.26	0.25	3.86	0.29	0.26
S13	4.84	0.36	0.2	2.97	0.21	0.29	3.26	0.23	0.27
S14	5.07	0.44	0.26	3.26	0.27	0.35	3.27	0.26	0.33
S15	5.14	0.41	0.22	3.09	0.23	0.31	3.27	0.25	0.31
S16	5.53	0.42	0.17	3.81	0.27	0.24	4.07	0.31	0.25
S17	5.11	0.39	0.19	3.02	0.22	0.3	2.83	0.22	0.35
S18	5.57	0.44	0.19	3.64	0.27	0.27	3.45	0.26	0.3
S19	5.35	0.4	0.18	3.61	0.27	0.27	3.47	0.27	0.3
S20	5.16	0.41	0.21	3.26	0.24	0.3	3.42	0.25	0.28
S21	5.11	0.41	0.22	3.54	0.27	0.29	3.5	0.26	0.29
S22	5.75	0.46	0.19	4.42	0.35	0.25	2.53	0.23	0.47
S23	4.63	0.32	0.18	2.74	0.16	0.23	2.68	0.16	0.23
S24	5.25	0.43	0.23	3.26	0.26	0.33	3.78	0.3	0.29
S25	4.24	0.31	0.23	2.51	0.17	0.31	3.05	0.24	0.34

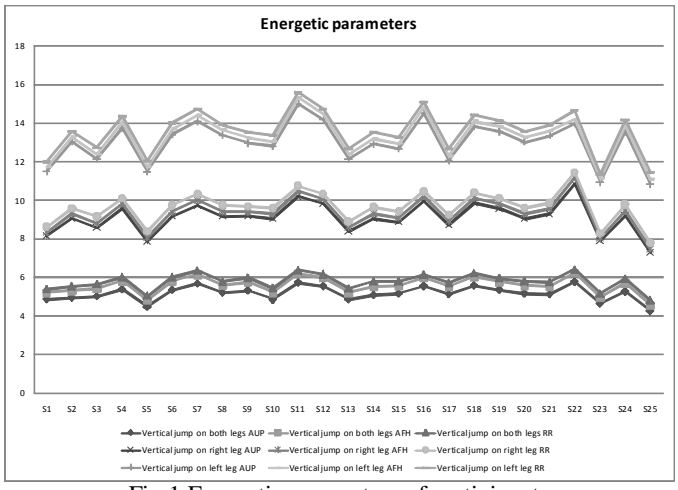

Fig.1 Energetic parameters of participants

4. DISCUSSIONS

For each participant in the MGM-15 test we can analyze the energetic parameters, as follows:

Participant 1 develops an average unit power which is 91.7% from the maximum possible power on vertical jump on both legs, 90.5% on the right leg and 87.5% on the left leg. The maximum developed power is 99.6% from the maximum possible power on vertical jump on both legs, 96.1% on the right leg and 96.5% on the left leg. The ratio force – velocity (-1.93) reveals an unbalanced training, with excessive force and lack of velocity (37.8%). As for the energetic asymmetry, that participant has almost the same qualities for the right and left leg (0.94%). The second energetic parameter, that characterizes the force during the effort, reveal the fact that this football player develops 86%-89% of the force during vertical jumps. The third energetic parameter reveals the speed during the effort which is very small for all vertical jumps.

Participant 2 develops an average unit power which is 86.7% from the maximum possible power on vertical jump on both legs, 87.6% on the right leg and 81.9% on the left leg. The maximum developed power is 99.1% from the maximum possible power on vertical jump on both legs, 96.2% on the right leg and 97% on the left leg. The ratio force – velocity (-2.04) reveals an unbalanced training, with excessive force and lack of velocity (41%). As for the energetic asymmetry, that participant has better qualities for the right leg (>2.01%). For the second energetic parameter that characterizes the force during the effort, this football player develops 78%-86% of the force during vertical jumps. The third energetic parameter reveals the speed during the effort which is very small for all vertical jumps.

Participant 3 develops an average unit power which is 91.4% from the maximum possible power on vertical jump on both legs, 86.4% on the right leg and 88.7% on the left leg. The maximum developed power is 96.7% from the maximum possible power on vertical jump on both legs, 95% on the right leg and 95.5% on the left leg. The ratio force – velocity (-0.94) reveals a small unbalanced training, with excessive velocity and lack of force (18.74%). As for the energetic asymmetry, that participant has better qualities for the left leg (>1.86%). For the second energetic parameter, that characterizes the force during the effort, we conclude that this football player develops 85%-93% of the force during vertical jumps. The third energetic parameter reveals the speed during the effort which is very small for all vertical jumps.

Participant 4 develops an average unit power which is 91.9% from the maximum possible power on vertical jump on both legs, 87.4% on the right leg and 87.9% on the left leg. The maximum developed power is 96.5% from the maximum possible power on vertical jump on both legs, 96.3% on the right leg and 96.3% on the left leg. The ratio force – velocity (-1.83) reveals an unbalanced training, with excessive force and lack of velocity (34.16%). As for the energetic asymmetry, that participant has better qualities for the left leg (>2.84%). For the second energetic parameter, that characterizes the force during the effort, we conclude that this football player develops 85%-93% of the force during vertical jumps. The third energetic parameter reveals the speed during the effort which is very small for all vertical jumps.

Participant 5 develops an average unit power which is 92.3% from the maximum possible power on vertical jump on both legs, 87.4% on the right leg and 85.2% on the left leg. The maximum developed power is 99.7% from the maximum possible power on vertical jump on both legs, 98.4% on the right leg and 96.4% on the left leg. The ratio force – velocity (-1.5) reveals an unbalanced training, with excessive force and lack of velocity (33.6%). As for the energetic asymmetry, that participant has better qualities for the right leg (>9.5%). The second energetic parameter, that characterizes the force during the effort, reveals that this football player develops 83%-89% of the force during vertical jumps. The third energetic parameter reveals the speed during the effort which is very small for all vertical jumps.

The same analysis can be performed for all participants at the test, revealing their individual characteristics.

Comparing their results with the average of the team we can see that for the average unit power (fig.3) computed on the vertical jump on both legs, 52% of participants develop unit power greater than the mean (5.157). The biggest value of power unit (5.75 – participant 22) is 11.49% greater than the team's average, while the smaller value of power unit (4.24 – participant 25) is 17.78% lower than the team's average.

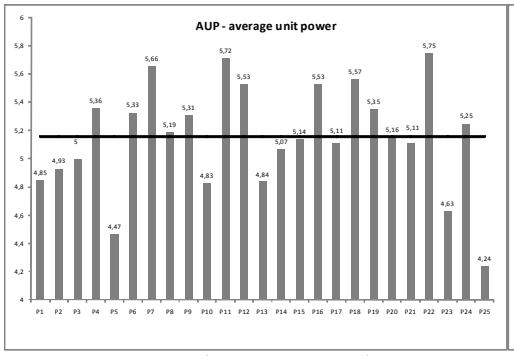

Fig.3 Average unit power

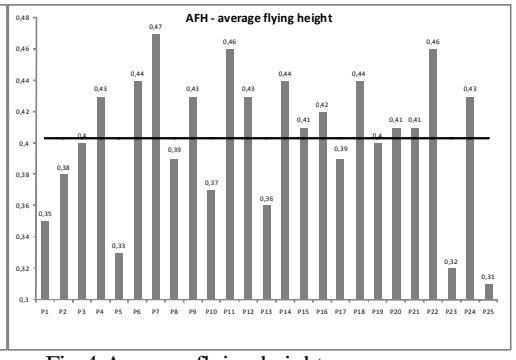

Fig.4 Average flying height

For the average flying height (fig.4) computed on the vertical jump on both legs, 56% of participants develop values of the energetic parameter greater than the mean (0.403). The biggest value of the parameter (0.47 – participant 7) is 16.56% greater than the team's average, while the smaller value (0.31 – participant 25) is 23.11% lower than the team's average.

The repetition ratio (fig.5) computed on the vertical jump on both legs, reveals the fact that 52% of participants develop values of the energetic parameter greater than the mean (0.203). The biggest value of the parameter (0.26 – participant 14) is 27.7% greater than the team's average, while the smaller value (0.17 – participant 16) is 16.5% lower than the team's average. For this energetic parameter, the interpretation of the results reveal the fact that participant 16 (which value of RR is the smallest) has the best performance in velocity effort from the whole team, even though the value ranks him in the group of athletes with normal speed. Seven participants meet the same condition for normal speed effort and shall be considered the best trained football players in speed effort of the team.

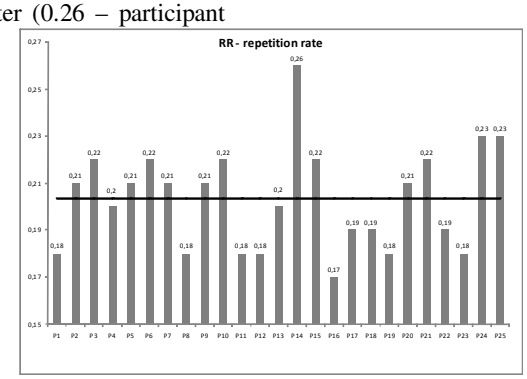

Fig.5 Repetition rate

5. CONCLUSIONS

The energetic parameters are important for the trainer that must act accordingly to the results, ensuring an optimum ratio force –velocity for the athletes which show unbalances. The values of that parameter, together with the values of the differential power and the skewness must provide to the trainer, information on the new approaches in training program, in order the get the optimum of the ratio force-velocity.

A well oriented trainer must prepare individual programs for each football player in order to correct the lack of force, velocity and the force-velocity ratio.

It is also important to measure again the energetic parameters after the training stage, in order to reveal that the training program was efficient, accordingly to the required demands.

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THE COMPLEMENTARY ENERGETIC PARAMETERS USED TO ESTIMATE THE TRAINING STAGE OF ELITE FOOTBALL PLAYERS

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Abstract

The paper presents the importance of some other energetic parameters, called complementary parameters achieved while performing a MGM experimental test. The experimental method originates from the test for determining the anaerobic capacity of effort in a force - velocity maximal effort test. A comparison between the complementary parameters of some football players and the values of the entire group is made. A regression analysis will reveal if some anthropometric parameters are influencing the data collected from the experiment.

Key-words: *maximum vertical height, the maximum unit power, the possible maximum unit power*

1. INTRODUCTION

Sports competition is the engine of sports development and also offers the opportunity to check the athletes' status of training. During the competition, the athletes prove the quality of their training, value the previous training stage, enrich their experience. The trainers must conceive such a physical preparation that takes into account the competition, as a method to reach the maximum preparation stage.

That is why, it is very important to determine the energetic parameters for the football players, at different stages of training, before the championship, at the middle at the end of the championship.

Based on the results of the experimental study (Dick - 2003), the team trainers must optimize the training program in order to get a special physical preparation, to improve the insufficient developed physical qualities (such velocity, force and endurance) and to assume peculiar training methods for each football player.

The proposed experimental study emphasizes the general energetic resources of a football player, considering that the muscle tissue has, besides motor qualities, elasticity and viscosity (Almeida, Hong, Corcos, and Gottlieb - 1995).

2. EXPERIMENTAL METHOD

In order to estimate the anaerobe capacity of effort, it was obvious that tests like Bosco's (Bosco, Colli, Bonomi, von Duvillard – 2000, Bosco at al. – 1983, Bosco, Luhtanen, Komi, - 1983), step test (Buckley & Eston - 2007) are not