Repetitive movements of upper limbs and risk of musculoskeletal disorders for workers during the cheese production in an Italian agro-food factory

M. Cecchini, R. Bedini, A. Colantoni, G. Menghini, D. Monarca

DAFNE Department of Agriculture, Forests, Nature and Energy - *University of Tuscia - via S. Camillo De Lellis, s.n.c. – 01100 Viterbo (Italy)*

Phone: +39 0761.357.357- ergolab@unitus.it , www.ergolab-unitus.com

INTRODUCTION

The aim of the research is to evaluate the risk of upper limb biomechanical overload for workers involved in processing one of the most popular DOC products in central Italy: Pecorino Romano.
In addition, we resolved to identify measures to reduce the risk of upper limb biomechanical overload for some specific tasks in one of the most important Italian agro-food factories.

MATERIALS AND METHODS

The "OCRA index" and "checklist OCRA"

The *OCRA index* is the model used in this experiment to evaluate the risks for upper limbs due to repeated strain. We chose this method because it is the official European Community (EC) method (EN 1005-5:2007) for assessing and controlling health and safety risks due to machine-related repetitive handling at high frequencies.
The recommendations provided by the standard are based on scientific evidence concerning the physiology and epidemiology of manual work (Grieco, 1998; CE N, 2007). Other reasons for choosing this method were that it is more complete in its coverage of the various sources of risk, it is able to identify the best elements to consider when designing worker locations and tasks, and it allows for damage prediction. Our model uses an "exposure index" (*OCRA* index), which is defined by the ratio:

$$OCRA_{index} = \frac{ATA}{RTA}$$

where *ATA* is the overall number of actual technical actions needed in the workers' shift, and *RTA* is the overall number of reference technical actions (i.e., the total number of actions recommended so as not to expose the workers to risks) in the shift. According to EN 1005-5:2007, an index value of 3,5 means that 95% of PA (persons affected) values in the exposed worker population are expected to be higher than twice the 50th percentile (PA = 3.7 × 2 = 7.4%) of the reference (not exposed) population. The *RTA* is obtained from the following equation:

$$RTA = CF \times Fo_M \times Po_M \times Ad_M \times Re_M \times (D \times Rc_M \times Du_M)$$

where *CF* is the "constant of frequency" of technical actions per minute recommended in good conditions (in the model, a recommended value of 30 actions/minute is assumed); *FoM*, *PoM*, *AdM*, and *ReM* are multiplicative coefficients, relative to each of the *M* jobs carried out by the worker, with values ranging between 0 and 1, chosen according to the behaviour of the risk factors force (*FoM*), posture (*PoM*), additional (*AdM*), and repetitiveness (*ReM*); *D* is the net duration of the repetitive task in minutes; *RcM* is the multiplier for the "lack of recovery period" risk factor, ranging between 0 and 1; and *DuM* is the multiplier for the overall duration of repetitive tasks during a shift.

MONITORED AGRO-FOOD FACTORY

Figure 1 The dairy analyzed.

Charges for diseases concerning the musculoskeletal apparatus in the working field are steadily increasing; for this reason a project for analysing this risk has been started in some firms in the agro industrial sector. For this purpose we have analysed the productive cycle concerning an important dairy situated near Rome where the famous "Roman Pecorino" cheese is produced.

RESULTS

In the case we are examining, we have taken into account the main repetitive movements done during the productive cycle, and we have realized that, in particular cases, the values are superior to the limits fixed by the standard EN 1005:07. The risk evaluation has been effected both with the help of checklists and with films and interviews to workers. The study of the tasks has brought to an evaluation of the index reported in the following chart (table 1).

Task	Limb	OCRA Checklist Index	Risk
Workers employed in salting – opening of cheese hoops (fascine)	Right	5,80	Acceptable
	Left	5,75	Acceptable
Workers employed in salting – predisposition of cheese hoops (fascine)	Right	6,00	Acceptable
	Left	6,00	Acceptable
Workers employed in salting – tightening of cheese hoops (fascine)	Right	19,00	Medium
	Left	15,00	Medium
Workers employed in waxing (grooming) and marking	Right	11,00	Very slight
	Left	2,25	Acceptable
Workers employed in making and predisposition on benches	Right	5,30	Acceptable
	Left	4,75	Acceptable
Workers employed in cutting "caciotte" and setting them on benches – cutting phase	Right	10,00	Very slight
	Left	8,25	Very slight
Workers employed in cutting "caciotte" and setting them in box – casing phase	Right	14,00	Medium
	Left	11,50	Medium

Table 1: Charts concerning risks for every working phase calculated through the *OCRA* index.

Therefore we have changed the working method so that the risk index could be contained within acceptable values, in order to avoid risks for the health of workers employed in these tasks. Workers employed in salting have been given a specific instrument which enables them to exploit lever effect, introducing longer working breaks (resting the involved limbs). Besides, it is advisable to use both limbs for all tasks, instead of using only the right limb (or the left for left-handed). In the waxing (grooming) phase the number of actions done in a minute have been decreased. The cutting of "caciotte" might easily be effected by special machines. It is possible to reduce risks, reducing the force factors (for example shifting more people in the same task, during the day or also alternating more frequently the making and cutting activities done by the same worker. In setting the "caciotte" in the special box it is necessary to slightly reduce the frequency (from 12 "caciotte" per minute to 10), so that workers may have short breaks. With the above mentioned changes to the productive cycle, the risk index becomes as in the following chart (table 2). As we can see, all the operations become acceptable for the potential consequences on the workers' health.

Task	Limb	OCRA Checklist Index	Risk
Workers employed in salting – opening of cheese hoops (fascine)	Right	5,80	Acceptable
	Left	5,75	Acceptable
Workers employed in salting – predisposition of cheese hoops (fascine)	Right	6,00	Acceptable
	Left	6,00	Acceptable
Workers employed in salting – tightening of cheese hoops (fascine)	Right	7,30	Acceptable
	Left	7,25	Acceptable
Workers employed in waxing (grooming) and marking	Right	7,50	Acceptable
	Left	7,50	Acceptable
Workers employed in making and predisposition on benches	Right	5,30	Acceptable
	Left	4,75	Acceptable
Workers employed in cutting "caciotte" and setting them on benches – cutting phase	Right	7,00	Acceptable
	Left	7,25	Acceptable
Workers employed in cutting "caciotte" and setting them in box – casing phase	Right	7,00	Acceptable
	Left	7,00	Acceptable

Table 2: Charts concerning risks for every working phase calculated through the *OCRA* index after improving the working methods.

CONCLUSIONS

In conclusion the present study shows that risks may be reduced through simple organizing systems or ergonomic studies in the workplace, without greatly influencing the economic aspects of production.