Economical sample tube rotary mixing device for molecular biology and diagnostic laboratories

Running title – Rotary mixing device for laboratory

Santosh Kumar[1], Ravi Shekhar[2]
[1]Senior Resident, [2]Additional Professor,
Department of Biochemistry, Indira Gandhi Institute of Medical Sciences, Patna
Corresponding Author: Dr Ravi Shekhar
Additional Professor, Department of Biochemistry, IGIMS,Patna
Sheikhpura, Patna – 800014, Bihar, Mobile: 7091022702
Email ID: ravishekhar1974@yahoo.com

Abstract

Rotatory mixing device is frequently and indispensible instrument in molecular biology, chemical and clinical laboratories. Depending upon the type of application they are used to mix samples in micro-centrifuge tube and polypropylene centrifuge tube (15 ml) in molecular biology labs. In clinical laboratories it is used to mix blood samples. The device cost ranges from ₹ 5,000 to ₹ 50,000 ($ 70 to 700). This is ridiculously expensive to do simple jobs. Due to this reason, most of the colleges and hospitals do not buy such products in developing countries and remote setups. We have tried to break this barrier by developing a very economic sample rotatory mixer that can be fabricated in less than ₹ 100 or $ 1.5.

Keywords: Rotatory mixer, Microcentrifuge tube, Polypropylene tube, Antibody labeling

Back ground

Antibody labeling and incubation techniques are used in conjugation with protein purification and identification. This process involves a mixture of antibodies and target that has to be labeled are put in a micro centrifuge tube and are rotated continuously to mix thoroughly on a slow speed (5-10 rpm) for hours. The instruments available in the market for such purpose are ridiculously expensive. There are many open source design that are democratizing science to make it available for low resource developing nations [1-2].We can address this issue by designing an economical rotary tube mixer that can be afforded and build by students. This device can also mix blood in 5 to 10 ml EDTA tubes to prevent clotting and can find application in medical diagnostic field too.

Materials and methods

Construction

This device can be assembled in around ₹ 100 or $ 1.5

Components

1. Microwave turn table motor
2. 3D printed parts or wooden sticks cut or glued with cyanoacrylate glue (Feviquick)
3. Rubber bands, screws
4. Two Pin plug (AC 230V, 1A)

Design

Figure 1: Dimensions for rotor leg
Figure 2: Dimensions for rotor head

The model for 3D printed parts can be freely downloaded from Tinker Cad website that is uploaded and designed by us on Online Tinker Cad software [3-4]. The 3 D parts were printed using Anet 3D printer using Poly lactic acid (PLA) filament [5,6,7]. If not possible 1cm x 1cm cross-section wooden sticks can be used that can be purchased from hardware

stores or can be salvaged from photo frames. For legs connect 7 cm and 5 cm sticks at 60 degree angle. (Figure 1, 3(a)) For the rotor, unite 5 cm pieces of wooden sticks with glue on a 2 cm diameter circular piece cut out from a 1 cm thick ply. (Figure 2) Fix two legs with the turn table motor with screw by drilling near the top end of the piece (Fig 3(b)). Drill a 6 mm hole in the rotor and snug fit the rotor on the shaft of the motor (Fig 3(c)). Glue the joints with cyanoacrylate or epoxy. Wrap small rubber bands on each of the eight arms of the rotor, this will hold the tubes. Connect a two pin plug to the wires for connecting it to 230 V AC mains (Fig 3(d)).

Fig 3 (a,b,c,d) shows the assembly of the sample rotator.

Results and discussion

Technical performance

The fully constructed open source laboratory sample rotator mixer has a fixed rotation rate 5 revolution per minute (rpm). The motor used in this device is a synchronous microwave turn table motor with inbuilt high torque gear mechanism [8]. This motor can turn 1 kg weight at the fixed speed of 5 rpm. The total weight handled by the rotor for tubes commonly used in laboratory is given in Table 1.

Type of loaded tubes used	Weight (each tube)	Number of tubes	Total weight
Micro centrifuge tube (1.5ml)	2.4 g	8	19.2 g
EDTA tube (5 ml)	10.5 g	8	84 g
EDTA tube (7 ml)	11.2 g	8	89.6 g
EDTA tube (10 ml)	16.8 g	4	67.2 g
Polypropylene centrifuge tube (15 ml)	21.8 g	2	43.6 g
Glass tube with stopper (5 ml)	10.53g	8	84.24 g
Glass tube with stopper (7 ml)	12.7 g	8	101.6 g

Table 1: The total weight the rotator mixer can handle without tipping and jerking.

Using Micro centrifuge tubes the load was easily handled and without balancing up to 8 tubes. EDTA tubes and glass tubes poses no problem. Polypropylene centrifuge tube (15 ml) required balancing to avoid tipping over.

Applications

In techniques of molecular biology requires antibody labeling and mixed appropriately before storage. Oligonucleotides labeling require continuous mixing of solution with components for long times at a very slow speed [9]. It is also required to rotate samples for conjugating protein with proteins [10]. Blood drawn in EDTA tubes requires mixing upto 8 tubes in 1 minute [11]. Most of the reagent mix preparation is done in 15 ml polypropylene tubes. Though this can be done with this device but two such tubes can be used in one go and that too need to keep the device on a height, approx 6 cm, to have some ground clearance.

Suitability and cost

The device is plug and play, thus easy to operate. It is practically maintenance free and only thing that need to be changed once in awhile is rubber bands. If motor fails, it can be replaced for ₹ 70 or $ 1.Power consumption of the device is only 3 watts and works on 230 V which can be plugged in 1 A commonly available sockets.

Conclusions

This article describes the process of fabrication of a simple open source laboratory sample rotator mixer using affordable and commonly available electrical components. The device can perform most of the jobs that an expensive rotator mixer device does. The open source

laboratory sample rotator mixer can be built by researchers, high school students without any assistance and technical knowledge under US$ 1.5.

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